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INSECT AND DISEASE CONDITIONS UNITED STATES, 1971

FOREST SERVICE
U. S. DEPARTMENT OF AGRICULTURE

FOREWORD

Our Forest Insect Conditions Report has been issued annually since 1951 to provide up-to-date information on the scope, severity, and trends of the more important forest insect infestations in the United States. It has been fairly standard in format and scope of contents since 1960. This year, however, the report has been expanded to include forest diseases. We hope the addition of disease conditions will increase the usefulness of the report by keeping forest land managers abreast of both groups of pests on their lands and neighboring lands.

Diseases are included with insects in the nationwide "Highlights" section and in the "Conditions in Brief" section of each regional report. Details of disease occurrences are in a separate section in each regional report.

In 1971 our major effort involved the gypsy moth. Federal and State pest control scientists spent many man-hours on surveys, evaluations, special studies, extension work, general coordination efforts, and preparation of Environmental Statements on this insect. In May and June some 336,000 acres in numerous small blocks in New Jersey, New York, and Pennsylvania were sprayed under State-Federal cooperation to protect tree foliage from gypsy moth feeding.

In our continuing effort to manipulate pest populations without the use of harmful pesticides and with limited adverse effects on the environment, attractants that influence insect behavior received increased attention by research and pest control scientists. Much has been learned. With some additional work, the near future should bring operational use of these materials for surveying and managing bark beetle populations.

A critical need is determination of the net impact of forest insects and diseases on people, the economy, and the environment. Recognizing this, 10 impact teams have been appointed, with each team assigned a pest problem. These teams will utilize all available knowledge and professional expertise in gathering needed impact information. This project will provide meaningful impact data to guide future work planning and setting of priorities for forest insect and disease management programs.

Pest control personnel will be interested in three recently published books. They are:

Hepting, George H.
1971. Diseases of Forest and Shade Trees of the United States. 658 p. USDA Forest Service. Agriculture Hand. 386.

Hawksworth, Frank G. and Delbert Wiens.
1972. Biology and Classification of Dwarf Mistletoes (Arceuthobium). 234 p. USDA Forest Service. Agriculture Hand. 401.

Baker, Whiteford L.
1972. Eastern Forest Insects. 642 p. USDA Forest Service. Misc. pub. 1175.

We gratefully acknowledge all Federal, State, county, and private agencies whose assistance and cooperation made this report possible. Special thanks go to Southeastern Area's Forest Pest Management Group, especially Entomologist James D. Ward, at Asheville, N.C., for assistance in compiling the report.

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Cover photo: Smog created in the Los Angeles Basin moves into the Arrowhead-Crestline area of the San Bernardino National Forest to seriously injure or kill ponderosa and Jeffrey pines. These affected trees become highly susceptible to bark beetles. Wherever possible pines killed outright by air pollution or secondarily by beetles are being salvage logged (*lower right*).

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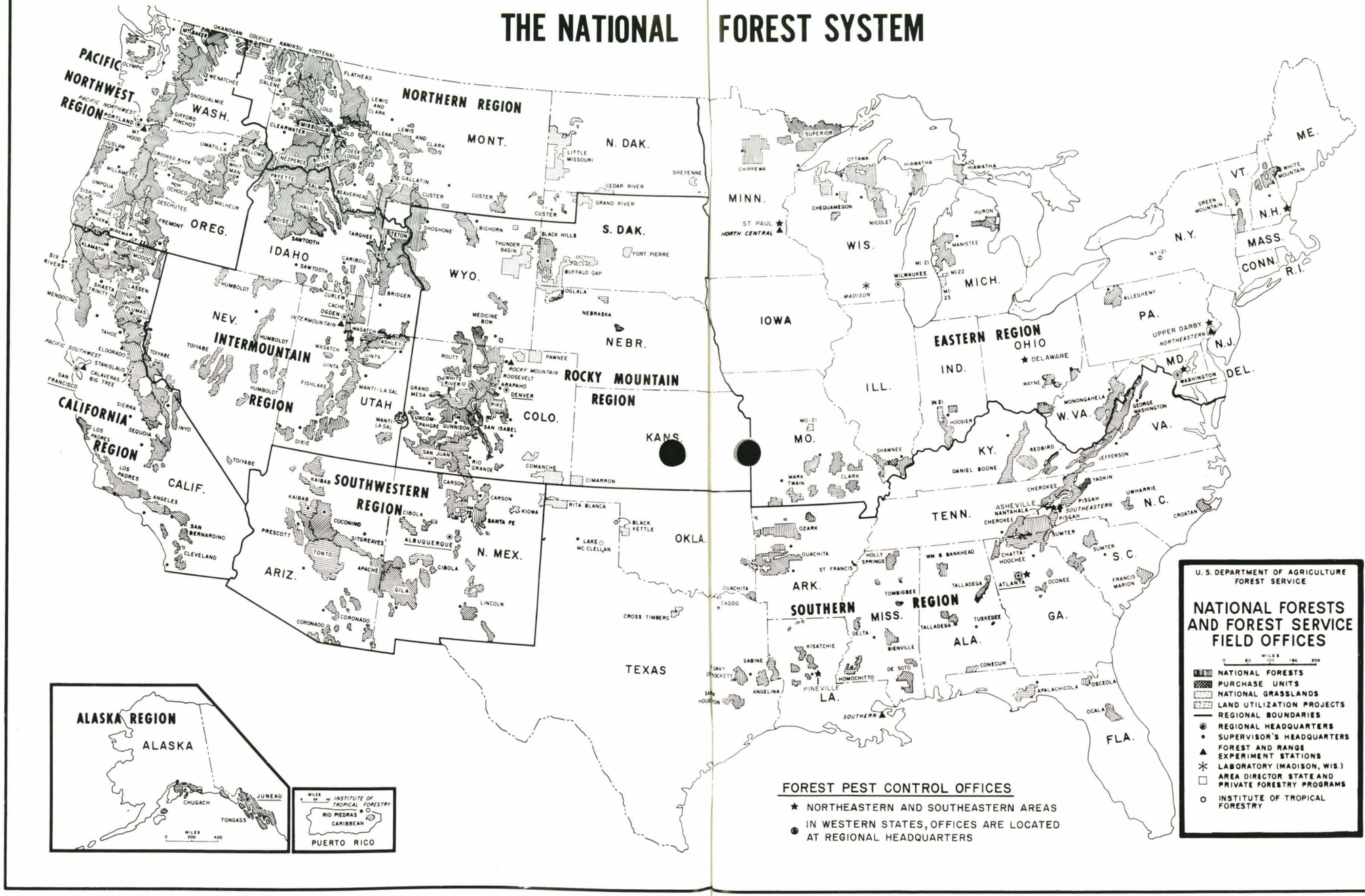
This publication reports research involving pesticides. It does not contain recommendations for their use, nor does it imply the uses discussed here have been registered. All uses of pesticides must be registered by appropriate State and/or Federal agencies before they can be recommended.

CAUTION: Pesticides can be injurious to humans, domestic animals, desirable plants, and fish or other wildlife—if they are not handled or applied properly. Use all pesticides selectively and carefully. Follow recommended practices for the disposal of surplus pesticides and pesticide containers.

The use of trade, firm, or corporation names in this publication is for the information and convenience of the reader. Such use does not constitute an official endorsement or approval by the U.S. Department of Agriculture of any product or service to the exclusion of others which may be suitable.

Issued August 1972

THE NATIONAL FOREST SYSTEM



Forest Pest Control offices are located at the following addresses; see map on pp. iv–v.

USDA Forest Service
Federal Building
Missoula, Mont. 59801

USDA Forest Service
Federal Center Building
Denver, Colo. 80225

USDA Forest Service
Federal Building
517 Gold Avenue S.W.
Albuquerque, N. Mex. 87101

USDA Forest Service
Federal Office Building
324 25th Street
Ogden, Utah 84401

USDA Forest Service
630 Sansome Street
San Francisco, Calif. 94111

USDA Forest Service
P.O. Box 3623
Portland, Oreg. 97208

USDA Forest Service
6816 Market Street
Upper Darby, Pa. 19082

USDA Forest Service
Federal Courts Building
St. Paul, Minn. 55112

USDA Forest Service
P.O. Box 365
Delaware, Ohio 43015

USDA Forest Service
P.O. Box 5895
Asheville, N.C. 28803

USDA Forest Service
2500 Shreveport Highway
Pineville, La. 71360

USDA Forest Service
1720 Peachtree Rd.
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USDA Forest Service
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P.O. Box 1628
Juneau, Alaska 99801

USDA Forest Service
80 Daniel St.
Portsmouth, N.H. 03801

HIGHLIGHTS

Situation in the Western States

Bark beetles continued to dominate the forest insect situation in the Western States. Several new outbreaks and many continuing ones caused severe timber losses. Dwarf mistletoes were the most destructive disease-causing agents. Infections of this parasitic plant occur from Alaska to the Southwest. The following discussion summarizes the most serious insect and disease problems in the various regions of the West.

In Alaska the overall forest insect situation improved in 1971. Epidemic spruce beetle populations persisted but tree mortality caused by this pest decreased. Western blackheaded budworm populations remained at endemic level for the sixth consecutive year. Dwarf mistletoe and hemlock dieback were two of the most important disease problems. Heartrot was reported as the most important problem in old-growth stands.

Bark beetles continued to be the most destructive group of forest insects in Oregon and Washington. Severe outbreaks of mountain pine beetle, Douglas-fir beetle, and fir engravers occurred throughout the region. Losses resulting from outbreaks of fir engraver were much less in 1971 but still were considered serious. Defoliator activity increased substantially with widespread damage occurring in hemlock, true fir, and Douglas-fir stands. Populations of western spruce budworm and western blackheaded budworm are increasing. Another important defoliator, the larch casebearer, continued to spread throughout the Pacific Northwest. The dwarf mistletoes were the major cause of growth loss in Oregon and Washington. Other noteworthy diseases were verticladiella root disease of Douglas-fir and Bynum's blight on ponderosa pine.

In California rapidly expanding Douglas-fir tussock moth populations were the major concern in 1971. New infestations were discovered at seven locations from Shasta County to Fresno County. Increased activity by the lodgepole needle miner occurred in Yosemite National Park. Bark beetle activity remained at a low level in most areas. A few of the more important forest diseases in California during 1971 were elytroderma needle blight, red band needle blight, verticicladiella root disease, and air pollution damage. Many of the air pollution-affected trees in San Bernardino County were infested by bark beetles.

Populations of several species of destructive forest insects increased in the Northern Rockies during 1971. Western spruce budworm defoliated 4.1 million acres in western Montana and northern Idaho and continued to spread northward in Montana. Increased activity occurred on portions of the Gallatin and Helena National Forests and Yellowstone National Park. The larch casebearer has now spread to all of the western larch type in the region. Severe infestation of mountain pine beetle continued on the Kaniksu and Flathead National Forests in Montana, and increased Douglas-fir beetle population occurred in Idaho. Populations of spruce beetle and fir beetle continued to decline. Dwarf mistletoes were the most important disease problem in the Northern Rockies. Root diseases, nursery diseases, and air pollution were also important problems in 1971.

The forests in the Intermountain States were plagued by a variety of insects in 1971. As usual bark beetles, particularly the mountain pine beetle, caused more timber damage than any other group of insects. Although overall mountain beetle activity was at the lowest level in several years, a large volume of lodgepole and ponderosa pine trees were killed. The most severe outbreak was on the Targhee National

Forest in Idaho. Populations of Douglas-fir beetle in southern Idaho are beginning to subside after remaining at epidemic levels during the last 2 years. The area infested by western spruce budworm increased on the Payette and Boise National Forests but decreased on the Bridger National Forest. Natural factors were responsible for reducing Douglas-fir tussock moth populations in southern Idaho. The most important disease in the Intermountain Region was dwarf mistletoe, which causes an estimated annual growth reduction and timber mortality of 135 million board feet. Annosus root rot, air pollution injury, and needle diseases were other important diseases given attention in 1971.

In the Central Rocky Mountains the most troublesome forest insects were mountain pine beetle and spruce beetle. Most spruce beetle infestations appear to be stable or decreasing, but windthrown trees resulting from several windstorms in the fall of 1971 may trigger increased spruce beetle activity in 1972. Mountain pine beetle populations continue to cause severe mortality in South Dakota, Colorado, and Wyoming. In the Black Hills losses caused by this beetle were estimated at 21 million board feet in 1971. The western spruce budworm outbreak on the San Isabel National Forest increased from 32,000 acres in 1970 to 113,000 acres in 1971. The dwarf mistletoes caused more growth loss than any other disease-causing agent. Lodgepole pine dwarf mistletoe was reported as the most prevalent species. Comandra blister rust is causing increased concern, especially in the lodgepole pine forests of northern and western Wyoming.

In the Southwestern States epidemic spruce beetle populations were reduced by abnormally low temperatures. Roundheaded pine beetle activity remained at epidemic levels on the Lincoln National Forest and Mescalero-Apache Indian Reservation in New Mexico. Defoliator activity increased in the Southwest in 1971. Western spruce budworm and western tent caterpillar were the most important defoliators. The most serious disease agent in the Southwest is dwarf mistletoe. Annual losses resulting from infection by ponderosa pine dwarf mistletoe my exceed 150 million board feet.

Situation in the Southern and Southeastern States

The southern pine beetle continues to be the principal forest insect requiring attention in the South and Southeast. During the summer of 1971 populations increased rapidly to epidemic levels over widespread areas of the region. Timber losses caused by this beetle were very severe on the Francis Marion National Forest in South Carolina where the infestation level was the highest it had been in 9 years. An outbreak on a 25,000-acre area of the Great Smoky Mountains National Park reached an infestation level of 1,000 infested trees per thousand acres of host type. Other southern pine beetle outbreaks occurred in Virginia, North Carolina, South Carolina, Tennessee, Georgia, Alabama, Mississippi, Louisiana, and Texas. Populations of ips engraver beetles were generally lower in 1971 than in 1970, however, increased activity did occur in Texas and Florida. The most important forest insect defoliators in 1971 were the variable oak leaf caterpillar, forest tent caterpillar, and several pine-feeding sawflies. The gypsy moth was trapped at locations in Virginia, North Carolina, and South Carolina. One small infestation was discovered in Pensacola, Fla., and promptly treated by the USDA Agricultural Research Service.

A variety of forest diseases caused concern in Region 8 during 1971. Southern fusiform rust was cited as one of the most serious and widespread forest diseases in the South. Annosus root rot caused severe pine mortality in several localized areas. A needle cast disease was epidemic during the spring of 1971 on 54 million acres of pine forest along the Gulf Coast. Other disease problems in 1971 included oak wilt, white pine blister rust, comandra blister rust, forest nursery diseases, and environmental contaminations.

Situation in the Lake and Central States and the Northeast

Defoliators continued to dominate the forest insect situation in the Eastern Region. More than 8 million acres of hardwood forests were

defoliated by the major hardwood insect defoliators in 1971. The impact of this defoliation was especially severe in intensively managed hardwood forests and in urban areas. The most important defoliators were gypsy moth, red-humped oakworm, variable oak leaf caterpillar, saddled prominent, and a complex of leaf rollers. Another 4.5 million acres of coniferous forest were defoliated by increasing populations of spruce budworm. The southern pine beetle outbreak on the Delmarva Peninsula in Delaware and Maryland continued to cause serious pine mortality. Other important forest insects in 1971 were various sawflies, balsam woolly aphid, Saratoga spittlebug, and pine root collar weevil.

Most of the forest disease problems remained stable or had reduced impact in the Eastern Region. Urban areas, forest nurseries, and Christmas tree plantations suffered losses due to disease. Some of the more important problems in nurseries and Christmas tree plantations include cylindrocladium root rot, lophodermium needle cast, and chrysomyxa needle rust. Dutch elm disease and anthracnose were serious problems in urban areas. Oak wilt, beech bark disease, and environmental contamination were also important in the Eastern Region during 1971.

Suppression Activities

The Forest Service, cooperating State agencies, and private landowners continued to emphasize suppression measures that have minimal impact on the environment but will accomplish control objectives. Cultural practices, use of natural enemies, and application of nonpersistant pesticides are but a few of the measures recommended in 1971 to reduce forest insect- and disease-caused losses.

Bark beetles and dwarf mistletoes were the major targets of control in the Western States. The most significant control decision was to terminate the large-scale project for suppressing mountain pine beetle populations on the Targhee National Forest in Idaho and Wyoming. Although this virulent outbreak continues to increase in severity, suppression was considered unfeasible for various reasons.

Elsewhere in the West, silvicultural measures, removal of infested trees, piling and burning, and limited chemical control were used to combat bark beetles. Other bark beetles requiring suppression in the West were Douglas-fir beetle, western pine beetle, spruce beetle, roundheaded pine beetle, and various engravers.

Dwarf mistletoes were the major targets of disease control in the West. Almost 28,000 acres were treated in 1971. Removing infected residual trees in logged areas was a primary means used to prevent future damage. Other disease problems requiring control measures include Dutch elm disease, white pine blister rust, and annosus root rot.

In the South and Southeast forest managers relied almost entirely on nonchemical measures for suppressing the southern pine beetle. Removal of infested trees and piling and burning were the primary suppression measures used in Alabama, Louisiana, Mississippi, North Carolina, Tennessee, Texas, and Virginia. Forest diseases requiring suppression in the South and Southeast were oak wilt, white pine blister rust, and several forest nursery diseases.

The only large-scale control projects in the Eastern Region during 1971 were directed against the gypsy moth. In total, 336,000 acres were aerially sprayed with carbaryl for gypsy moth suppression. Oak wilt and white pine blister rust were two disease problems that required control efforts in the Eastern Region.

A number of field tests and pilot projects were conducted in 1971 to evaluate promising methods for controlling important forest pests. Zectran, aerially sprayed on 10,000 acres in Maine for control of spruce budworm, destroyed 96 percent of the budworm population. Also a pilot test of this insecticide was conducted on 9,000 acres in Idaho to further evaluate its effectiveness in reducing western spruce budworm populations. A pilot test using dylox against the gypsy moth in Pennsylvania indicated that this insecticide was effective.

In California, continuing studies to determine the effectiveness of synthetic attractants for suppression of western pine beetle showed promising results in 1971.

Two important pilot tests for control of

forest disease are underway in the Southern and Southeastern States. Stump treatments are being evaluated for prevention of annosus root rot infection, and a fusiform rust resistance test facility is under evaluation at Asheville, N.C.

A summary of major pest control operations for 1971 is presented in the following table:

Pest Control Accomplishments in the United States, 1971

Insect and location	*Trees treated*	*Acres treated*
Southern pine beetle—South, Southeast, Maryland	197,665	------
Mountain pine beetle—Idaho, Montana, Oregon, South Dakota, Colorado, Wyoming	211,093	------
Mountain pine beetle—Oregon	------	1,970
Mountain pine beetle and spruce beetle—Colorado	14,703	------
Spruce beetle—Washington	2,400	------
Spruce beetle—New Mexico	------	8,500
Roundheaded pine beetle—New Mexico, Nevada	510	------
Ips bark beetles—Idaho, Arizona	1,450	------
Bark beetle [1]—California, Oregon	9,822	------
Bark beetle [1]—Oregon, Montana, Arizona	------	35,711
Gypsy moth [2]—Pennsylvania, New Jersey, New York	------	336,136
Spruce budworm—Maine, Idaho (pilot tests)	------	19,000
Pine tip moths—California, Mississippi, North Carolina, Louisiana	74,346	864
European pine shoot moth—Washington	864	------
Pine reproduction weevil—California	4,000	40
Redheaded pine sawfly—Michigan (pilot test)	------	46
Douglas-fir cone moth—Washington	66	30
Totals for insects	516,919	402,297
Disease and location		
Dwarf mistletoe—Western States	------	27,703
White pine blister rust—Northeast, Lake States, Oregon	------	37,271
Oak wilt—Pennsylvania, West Virginia, Virginia	5,524	------
Annosus root rot—Washington	6,000	------
Dutch elm disease—Nebraska	550	10
Totals for diseases	12,074	64,981

[1] Various bark beetles, including western pine beetle, Jeffry pine beetle, ips, and borers.
[2] Includes a 400-acre pilot test; several States treated a few additional acres.

FOREST INSECT AND DISEASE CONDITIONS IN THE VARIOUS REGIONS

ALASKA (R-10)

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Conditions in Brief

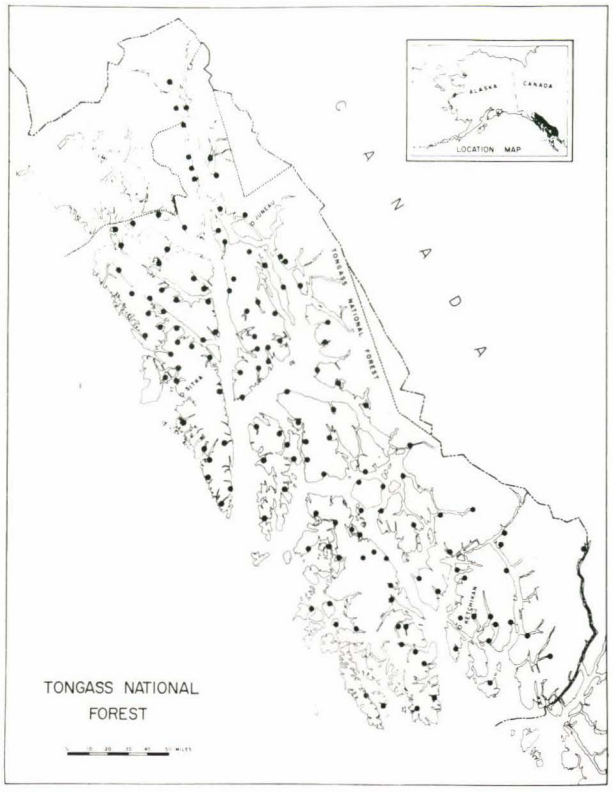
The spruce beetle outbreak continued in portions of the white spruce stands on the Kenai Peninsula with increased tree killing in a few old locations and the development of some new centers. Overall the amount of mortality produced by this pest has decreased. The scattered infestations in the south-central and interior portions of the State are declining. Portions of the chronic infestation in the Granite Creek Drainage of the Anchorage Ranger District that were treated in 1968-1970 remained at endemic levels. The anticipated spruce beetle buildup in scattered blowdown on portions of the Chugach National Forest has not materialized.

Defoliation by the hemlock sawfly was observed at several locations in the southern portion of southeast Alaska. The defoliation was generally light to moderate except for one area on the west side of McKenzie Inlet where feeding for four consecutive summers has caused top killing and some mortality. Western blackheaded budworm populations virtually vanished from the Prince William Sound and continued mostly at endemic levels throughout southeast Alaska. Visible defoliation was observed at one location in Princess Bay on Revillagigedo Island. Defoliation caused by a sawfly on alder was observed at several locations in southeast Alaska. A spittlebug infestation was observed on Sitka spruce seedlings at several locations on Mitkof Island near Petersburg. Populations of the green spruce aphid have declined without causing further damage. No projects were undertaken to control defoliating or sucking insects during the past year.

An extensive forest disease survey was made on second-growth stands in southeast Alaska during 1971 by Douglas R. Miller, Consultant Pathologist from R–5, Tom Laurent of the Institute of Northern Forestry, and Don Curtis, Assistant Regional Entomologist, R–10. Results of the survey indicate that the second-growth stands examined were generally in good health. Although many fungi and other disease-inducing organisms were observed in or adjacent to the young stands, only two were causing serious damage. Probably the most serious pest was dwarf mistletoe in western hemlock. Although dwarf mistletoe is widespread and is causing serious damage in old-growth stands in southeast Alaska, losses in second-growth stands are limited to areas where infected overstory hemlock trees remain. A second disease-causing organism which was found extensively in second-growth stands was a tip- and leader-killing fungus, tentatively identified as *Sirococcus strobilinus* Preuss.

In old-growth stands, dwarf mistletoe is abundant in western hemlock. The more heavily infected trees are so weakened that they eventually succumb to the infections, or they become easy prey for other disease-producing agents and insects. Since the majority of the present forest, particularly in coastal Alaska, is old growth, the most pressing problems in these stands are caused by wood-rotting fungi.

The forest inventory in coastal Alaska indicates that one-fifth of the gross volume of merchantable timber is unusable because of defects, mostly rotted wood.



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Thorough sampling is often a must in keeping track of population trends, as illustrated by the distribution of 150 sample points used for a larval survey of defoliating insects in southeast Alaska (Tongass National Forest).

Status of Insects

Spruce beetle, *Dendroctonus rufipennis* (Kby.). Spruce beetle activity continued to kill thousands of white spruce on the Kenai National Moose Refuge and adjacent State and private lands on the Kenai Peninsula. The acreage within the general zone of infestation has not significantly changed since last year. However, tree killing has increased in the northeast portion of the Moose Refuge between Falcon and Wonder Lakes and around the south and west edges of Barbara Lake. Additional new centers totaling an estimated 400 acres were observed along Mystery Creek from Fuller Lake downstream for approximately 8 miles.

The present epidemic, active since 1966 and now encompassing approximately 260,000 acres, is responsible for more than 1 billion board feet of sawtimber mortality on the Kenai National Moose Refuge and adjacent State and private lands. Ground and photo sample data indicate that growing stock 5 inches in diameter at breast height and larger has been reduced on an average of 14 percent. The greatest losses are occurring in the 10 inches and larger diameter classes.

In general the effect of this outbreak on spruce stands which typically contain 150 or more trees per acre is no more serious than a diameter selection cut which alters the stand structure but has no real effect on stocking. However, in the typical mature mixed stands of spruce and hardwoods, consisting primarily of larger diameter trees and containing little or no spruce regeneration, both the stand structure and the stocking are seriously affected. A sampling in portions of these stands north of the Sterling Highway indicates a total drain of more than 80 percent. Approximately one-third of the present infestation occurs in this type of mixed stand.

These outbreaks are expected to continue through 1972. Tree killing will increase in mature stands that are now lightly infested. However, it appears that this infestation has peaked and is now declining. A comparison of the green infested, red-top, and older mortality classes on 20 areas within the infestation indicates that the greatest amount of tree killing occurred during the summer of 1969. This corresponds with weather data which indicate that 1968 and 1969 were the peak seasons for the locally severe drought which is now subsiding.

However, locally severe tree killing is expected to occur for one or two more seasons in stands that are now lightly infested. The broods in trees examined in these areas are vigorous and abundant and appear to be little affected by natural control factors.

The ultimate course of this infestation will be largely governed by the type of weather occurring during the next two flight seasons and by the amount of suitable host material remaining in these outbreak areas. No direct control is being considered at this time.

The anticipated buildup of spruce beetle populations in portions of the Six-Mile River

and Resurrection Creek Drainages and the Summit Lake area of the Anchorage and Kenai Ranger Districts has not materialized. Examination of blowdown resulting from a late 1969 storm indicates that light, widely scattered broods are developing but pose no immediate threat to adjacent green trees. Emerging populations are expected to infest the remaining green blowdown during 1972 and 1973. No control is being considered at this time. However, it is recommended that concentrations of down material be logged within a year.

Subnormal temperatures and increased precipitation have resulted in a general decline of scattered infestations in the south-central and interior portions of the State. However, light mortality will continue to occur in recreation areas and in stands adjacent to land-clearing operations.

The treated portions of the chronic infestation in the Granite Creek Drainage of the Anchorage Ranger District remained at endemic levels. Few attacks were observed in green standing trees in either the control area or in adjacent stands. However, small amounts of blowdown scattered throughout the control area were found to be lightly infested. It is assumed that spruce beetle activity in this area will remain endemic for the next 1 to 2 years. No bark beetle control projects are planned for 1972.

A cedar bark beetle, *Phloeosinus squamosus* Blkm. Attacks by this beetle increased at several locations on Kupreanof, Prince of Wales, and Revillagigedo Islands and along the mainland from Bradfield Canal to Portland Inlet. Tree killing was confined to stands growing on poor sites at middle and upper elevations. Low elevation stands of neither red nor yellow cedar appear to be affected.

Western blackheaded budworm, *Acleris gloverana* Wlshm. Populations of this pest remained at endemic levels for the sixth season in southeast Alaska. The only defoliation observed during an aerial detection survey occurred over approximately 10 acres at Princess Bay on Revillagigedo Island. However, larval sample data indicate that populations are generally present over the southern portion of southeast Alaska and occur in relatively large numbers on Revillagigedo Island and the eastern half of Prince of Wales Island. An increase in budworm activity is expected in 1972 because of the high survival rate in the larval stages and the ideal weather which occurred during the oviposition period in September. In the Prince William Sound area populations have dropped to very low levels. Sampling revealed only four eggs on the more than 1,000 branches collected from eight different areas within the three 1969 infestation centers. Very low populations are expected again in 1972.

A saddleback looper, *Ectropis crepuscularia* (D.&S.). The saddleback looper outbreak reported in 1969 has subsided after causing an estimated 2 million board feet of mortality over 200 acres at Connell Lake. No control was necessary; however, plans are now being made to salvage dead and dying trees. Larval survey data indicate that low level populations exist at a few scattered locations in southeast Alaska. This looper is expected to remain at endemic levels in 1972.

Hemlock sawfly, *Neodiprion tsugae* Midd. Defoliation caused by this pest was observed at many locations in southeast Alaska, with the majority of the centers located in the Cholmondeley Sound-Moira Sound area on Prince of Wales Island. The damage is variable but generally light to moderate, except on the west side of McKenzie Inlet where continuous feeding for 4 years has resulted in limited amounts of top killing and mortality. Sampling conducted in midsummer indicates that larval populations are well distributed throughout southeast Alaska and exist in heavy concentrations at Polk Inlet, McKenzie Inlet, Connell Lake, Princess Bay, El Capitan Passage, Neets Bay, Stevenson Island, and Thorne Island. Considering the high survival rate of most larval populations and the exceptionally favorable weather which occurred during the oviposition period, populations of this insect are expected to greatly increase in 1972.

A noctuid moth, *Orthosia hibisci* (Guen.). Extremely high populations of this exotic defoliator have collapsed following one season of feeding over several hundred acres of mixed hardwoods on State and private lands along Turnagain Arm on the Kenai Peninsula. The reasons for the decline include parasitism by a species of *Aphanistes* and apparent physiological malfunctioning resulting in a 50 percent reduction of pupae. Examination of samples of affected pupae by insect pathologists at the Forestry Sciences Laboratory at Corvallis, Oreg., failed to reveal any apparent pathogens. Populations are expected to be low again in 1972.

Cooley spruce gall aphid, *Adelges cooleyi* (Gill.). This aphid was active again at a few locations on the Kenai Peninsula and near Anchorage but has subsided in southeast Alaska. Infestations on ornamental spruce have produced a noticeable amount of tip galling which is resulting in stunted and deformed trees. Wild stands appear to be little affected. No control is being considered.

Spruce aphid, *Elatobium abietinum* (Wlk.). Spruce aphid populations, active at several locations in southeast Alaska last year, have subsided after causing some locally severe defoliation and tree killing. The most serious damage occurred near Sitka, Alaska, on State and private lands where several hundred esthetically valuable Sitka spruce were killed. Additional severely defoliated trees are now being invaded by populations of spruce beetle which developed in adjacent windthrown trees. Sample data indicate that aphid populations will be at a very low level in 1972.

A sawfly. Populations of an unidentified species of sawfly have severly defoliated alder stands at several locations in southeast Alaska. The heaviest defoliation occurred over approximately 200 acres on three small islands at the mouth of the Stikine River near Wrangell, Alaska. The trend of these infestations is not known. No control is being considered in 1972.

A spittlebug. Infestations of a spittlebug, presumably a species of *Aphrophora,* were observed on Sitka spruce seedlings in several of the clearcuts within the Falls Creek Unit on Mitkof Island near Petersburg, Alaska. This is within an area that was fertilized in 1970. The trend of this infestation is not known.

Status of Diseases

Hemlock dieback, *Sirococcus strobilinus* Preuss. This pycnidial fungus is causing severe damage and minor amounts of mortality over an estimated 8,000 acres or more of western hemlock reproduction at Thomas Bay near Petersburg and at Edna Bay on Kosciusko Island. Additional areas of lighter infection, presumably caused by this disease, have been observed on Mitkof, Revillagigedo, and Prince of Wales Islands. Very little is known about this disease. It was tentatively identified in Alaska from samples sent to Dr. A. Funk, a forest pathologist with the Forest Research Laboratory, Victoria, B.C., Canada, in 1969. He reported that it is undoubtedly an infectious disease and that it may be related to frost damage as well as other factors which weaken the host. A great deal of winter drying and frost damage occurred in southeast Alaska during the winter of 1967-1968, severely affecting the problem area in Thomas Bay. The disease appears to attack hemlock trees from 6 inches to about 30 feet in height. At Thomas Bay trees in the 2 to 6 foot range seem to be most heavily infected, while at Edna Bay trees 20 to 30 feet high are being heavily attacked.

Data collected from plots established in the Thomas Bay area illustrate the severity of the current infection. On September 1, 1971, of 255 trees tagged in 10 widely scattered locations, 66 percent were infected, with 26 percent showing symptoms on both the terminal and lateral branches. Several individual plots contained more than 90 percent infected trees. Six weeks later, on October 18, 100 percent of the tagged trees in all 10 locations showed some symptoms of infection.

The young second-growth stands in southeast Alaska are generally overstocked and might benefit from some natural hemlock mortality. However, there is cause for concern about the apparent rapid rate of spread of this

disease as well as the extension of this disease or an associated disease to Sitka spruce. Monitoring of the plots at Thomas Bay will be continued, and additional plots are being established at Edna Bay on Kosciusko Island. Studies on the life cycle of the disease are imperative and research on the rate of development and pathogenicity of the disease are needed before meaningful biological evaluation can be made.

Hemlock dwarf mistletoe, *Arceuthobium tsugensis* (Rosendahl). This parasitic plant is prevalent on western hemlock throughout much of southeast Alaska although a number of stands free of infection do occur. Institute of Northern Forestry files record observations of hemlock mistletoe at the northern extremity of the Tongass National Forest at Haines, Alaska. It has not been found north of Icy Straits to the west or on the Yakutat Unit of the Tongass National Forest.

An extensive examination of the dwarf mistletoe situation in western hemlock forests of southeast Alaska was made in June 1970 by K. R. Shea and J. L. Stewart. An earlier field examination was made in July 1966 by D. P. Graham. Both examinations determined that hemlock dwarf mistletoe is causing serious damage, comparable at least to that reported in British Columbia in many hemlock stands. The damage includes growth loss, deformities and cull, general decadence, and predisposition of trees to damage or mortality from other causes. In dense young sapling stands the more heavily infected trees are so stunted that they are soon suppressed by their more vigorous neighbors. Unless infected residuals remaining after current logging are cut or killed, mistletoe damage is predicted to be greater in future stands than in present ones. A few infected overstory trees can reinfect an acre of hemlock regeneration. Infection will, therefore, occur earlier than it did in the original stands and intensify more rapidly in these regenerating forests so long as an overstory source of infection remains.

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These mature western hemlock on Kosciusko Island, Alaska, are heavily infected with dwarf mistletoe (Tongass National Forest).

Although quantitative data are lacking for southeast Alaska, available evidence suggests that growth and quality reduction warrant a program of direct control action. The present control program specifies cutting all residual hemlock whips 4 inches in diameter at breast height or 4 feet tall and larger after clearcutting. The cost per acre for contracting this work has averaged approximately $14 per acre for the last 2 or 3 years. The residuals are cut as soon as possible after logging and in no case is removal deferred more than 5 years after logging. Preliminary control plans are based upon data collected at the time of timber sale preparation. These data are usually supplemented by a presuppression survey made for specific control projects. Some reinvasion of mistletoe into the regenerated hemlock stand will occur along infected cutting boundaries. Under present cutting practices, this infection source is not economically serious enough to justify additional expenditures for control in

border areas. If the size of a clearcut is less than 40 or 50 acres, the relative importance of infected trees on the perimeter of the clearcut will increase. It may then become necessary to include these border infection sources in the control program. The same principle would apply where landscape management practices drastically increase the ratio of perimeter to area cutover. The current level of the dwarf mistletoe program in the region is approximately 6,000 acres of survey and 2,000 acres of treatment annually. This program is expected to double within the next 2 years.

Western gall rust, *Peridermium harknessii* J. P. Moore. This rust disease on lodgepole pine appears to be increasing. It is widespread throughout much of southeast Alaska as it has been for a long period of time. It is particularly heavy in the Petersburg area. Many complaints and requests for control information are received from persons who have made ornamental plantings of the native lodgepole in southeast Alaska.

Needle cast, *Lophodermium pinastri* (Schrad. ex. Fr.) Chev. This foliage disease of lodgepole pine was found to be prevalent throughout southeast Alaska in 1971. While the disease is quite distinctive and at times spectacular, with needles turning red and falling, it has so far proven quite harmless. No control measures are recommended.

A needle rust of Sitka spruce, *Chrysomyxa ledicola,* Pk. Lagerh. This rust caused quite spectacular and widespread discoloration of infected needles throughout southeast Alaska this past summer because climatic conditions were particularly favorable for full development of the disease. Evidence of this disease varies in intensity from year to year according to climatic conditions so that a heavy infection extending over a period of years would be exceptional.

OREGON AND WASHINGTON (R-6)

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Conditions in Brief

The most destructive insects were various bark beetles that attack pines, true firs, and Douglas-firs. Epidemic outbreaks occurred on 695,910 acres with an estimated loss in excess of 180 million board feet. The mountain pine beetle, Douglas-fir beetle, and fir engraver were the most destructive beetles.

Defoliators caused widespread damage in hemlock, true fir, and Douglas-fir stands in Washington and Oregon. Damage increased from 97,000 acres in 1970 to 260,000 acres in 1971. Outbreaks of western spruce budworm and western blackheaded budworm increased substantially. The Douglas-fir tussock moth reappeared in Washington causing some tree mortality. The larch casebearer continued to spread in both States.

Significant forest disease problems in the Pacific Northwest during 1971 included dwarf mistletoes, verticicladiella root disease, and various foliage diseases. The annual growth loss attributed to the most important disease, dwarf mistletoe, was estimated at 147 million cubic feet of timber.

Status of Insects

Mountain pine beetle, *Dendroctonus ponderosae* Hopk. Serious losses occurred in many pine stands throughout eastern Oregon and Washington. Most of the beetle activity was detected in lodgepole pine stands, principally in Oregon where 76 million board feet of timber was killed on 248,470 acres. The most severe and extensive outbreaks were reported on the Wallowa-Whitman, Fremont, Deschutes, Winema, and Umatilla National Forests. Commercial sales are planned to log as much as possible of the merchantable uninfested stands in the vicinity of the outbreaks to reduce the rate of spread of the beetle.

Old-growth stands of western white pine in the Cascade Mountains were also attacked by the mountain pine beetle. The majority of the damage occurred in Oregon on the Willamette, Mount Hood, and Umpqua National Forests. A slight increase in infested area was observed in Washington, primarily on the Snoqualmie and Wenatchee National Forests and Yakima Indian Reservation.

Regionwide, mountain pine beetle activity in dense, pole-sized ponderosa pine stands remained static. The majority of tree killing occurred in Oregon, but a decline in area and intensity was noted. The most serious infestation was on the Wallowa-Whitman National Forest. Significant outbreaks also occurred on the Deschutes and Malheur National Forests. In Washington a slight increase of beetle activity was reported, with most of the mortality occurring on the Snoqualmie National Forest and Yakima Indian Reservation. Because these outbreaks occur in overstocked stands, thinning is recommended to reduce the stand basal area and subsequent beetle attack.

Douglas-fir beetle, *Dendroctonus pseudotsugae* Hopk. Outbreaks on the west side of the Cascade Mountains were triggered by a severe ice storm in January 1970. As a result of this storm an estimated 7.3 million board feet of timber was infested. The heaviest losses, about 5.3 million board feet, occurred in the Clackamas, Collawash, and Hood River Drainages on the Mount Hood National Forest. Ground surveys indicate this outbreak is subsiding. In western Washington, the heaviest infestations were reported in the Wind River and Little White Salmon River Drainages on the Gifford Pinchot National Forest. A large beetle population is still present in these drainages and additional losses are expected to occur next year. Removal of infested trees is underway to minimize losses.

Douglas-fir beetle activity east of the Cascade Mountains increased in Oregon, particularly on the Umatilla and Wallowa-Whitman National Forests. Outbreaks in eastern Washington subsided with most of the losses occurring on the Okanogan and Umatilla National Forests and the Colville Indian Reservation.

Fir engraver, *Scolytus ventralis* LeC. Losses attributed to this beetle declined from 138 million board feet in 1970 to 46 million in 1971. The heaviest concentration of activity still persists on the Umatilla National Forest in Oregon and Washington. Significant losses were reported also on the Winema and Wallowa-Whitman National Forests in Oregon and on the Okanogan National Forest in Washington.

Western pine beetle, *Dendroctonus brevicomis* LeC. Scattered infestations of the western pine beetle in Oregon and Washington subsided during 1971. The heaviest concentrations of this beetle were on the Snow Mountain District, Malheur National Forest, Oreg., and in Asotin and Columbia Counties, Wash.

Other bark beetles. Another bark beetle species causing concern in local areas was the spruce beetle, *Dendroctonus rufipennis* (Kby.). An estimated 1.3 million board feet of timber was killed in Oregon and Washington. About half of this loss occurred on inaccessible and dedicated lands.

The pine engravers, *Ips* spp. Engravers caused damage on nearly 40,000 acres in Oregon. In Washington the pest was widely scattered with total loss less than a thousand acres.

Silver fir beetles, *Pseudohylesinus* spp. Activity by these beetles declined sharply with only minor damage reported on the Mount Baker and Olympic National Forests in Washington and Mount Hood National Forest in Oregon.

Douglas-fir tussock moth, *Hemerocampa pseudotsugata* McD. Infestations causing severe defoliation were detected at several widely scattered locations on the Wenatchee and Okanogan National Forests in Washington. A fall survey for overwintering egg masses on the Wenatchee infestations revealed most of the larvae had died in the late instars but the cause of mortality could not be determined.

The result, however, is significant, showing direct control to be unnecessary. The outbreaks on the Okanogan National Forest were smaller in size and less severe. Egg surveys in these infested areas indicate the population will increase in the 1972 season. Field experiments of promising insecticides and/or virus are being considered for 1972.

Subendemic levels of tussock moth populations were noted on the Umatilla, Wallowa-Whitman, and Winema National Forests. Although no visible damage was present, these populations will be closely watched. No control is planned in these areas.

Western spruce budworm, *Choristoneura occidentalis* Free. Infestations on Wallowa-Whitman National Forest in Oregon and Wenatchee and Okanogan National Forests in Washington caused light to moderate defoliation. Ground surveys also revealed a significant population of budworm along the eastern slopes of the Cascade Mountains in Washington. No control is planned.

Western blackheaded budworm, *Acleris gloverana* Wlshm., populations on western hemlock increased sharply on the Olympic Peninsula and the Gifford Pinchot, Snoqualmie, and Mount Baker National Forests in Washington. If these infestations continue to increase, defoliation is expected to reach a serious level late in the 1972 season.

Larch casebearer, *Coleophora laricella* (Hbn.). The larch casebearer continued to extend its range in Washington and Oregon. With a few exceptions, all larch stands from west-central Okanogan County, Wash., eastward to the Idaho border are now infested. Another infestation in Asotin and Garfield Counties in southeast Washington extends south into northeast Oregon. The infestations in Oregon have spread rapidly and have been detected as far west as Ukiah.

A larch budworm, *Zeiraphera improbana* (Wlk.). The populations of this pest declined. The infestation on the Snoqualmie National Forest in Washington encompassed only 880 acres in 1971, with defoliation classified as very light. The population present on the Wenatchee National Forest in 1970 collapsed.

Sawflies, *Neodiprion* spp. Sawfly damage was relatively common on pines and firs in southern Oregon. An unidentified species of sawfly continued to defoliate knobcone pine on the Siskiyou National Forest. The damage in 1971 was light, subsiding from 2,000 to 1,100 acres. The outbreak is located on poor sites. The white fir sawfly, *Neodiprion abietis* (Harris), caused light defoliation of true firs on the Winema National Forest. Surveys indicate the population was heavily parasitized and little or no defoliation should occur in 1972. A minor infestation of the twolined larch sawfly, *Anoplonyx occidens* Ross, was detected on the Wallowa-Whitman National Forest.

Lodgepole needle miner, *Coleotechnites* near *milleri* (Busck.). For the first time since 1964 no damage associated with this pest was reported. Several lodgepole pine stands in central Oregon had been heavily defoliated during the past 7 years. Long-term studies are in progress to evaluate the insects impact in these stands.

Pandora moth, *Coloradia pandora* Blake. The only active population detected in 1970 is located east of Newberry Crater on the Deschutes National Forest in Oregon. This pest had defoliated more than 5,000 acres of lodgepole and ponderosa pine last year. After overwintering as pupae, moth flight began July 13, 1971. First and second instar larvae were observed feeding in the fall. Although control is not required, this population will be watched closely in 1972.

Balsam woolly aphid, *Adelges piceae* (Ratz.). Damage by this insect was lower although losses still remain high in true fir stands throughout the Cascade Mountains in Oregon and Washington. Most losses in Washington were located on the Snoqualmie and Gifford Pinchot National Forests. An outbreak on the east side of the Olympic Peninsula continued to kill trees. This outbreak has not yet spread into Olympic National Park. In Oregon the

heaviest losses occurred on the Mount Hood, Willamette, Umpqua, and Rogue River National Forests.

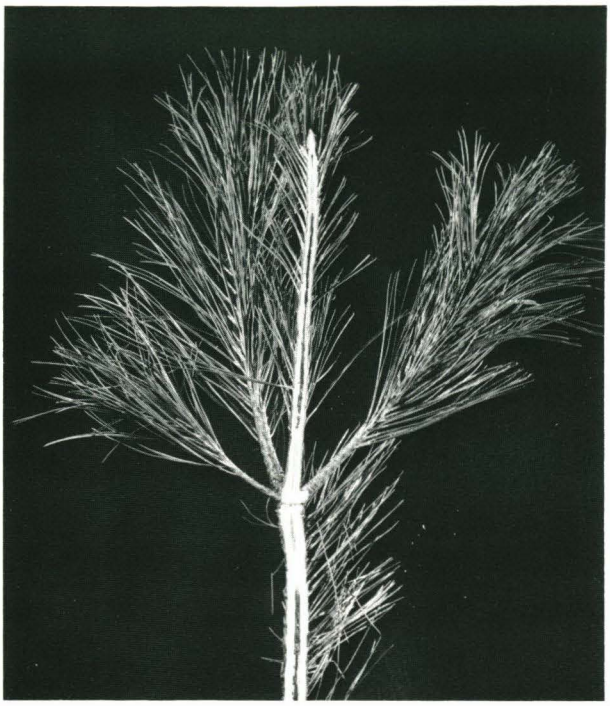
Spruce aphid, *Elatobium abietinum* (Wlk.). Minor defoliation occurred on 200 acres of Sitka spruce along the Washington coast. Reports of this aphid causing injury to ornamental spruces were common in several communities in western Oregon and Washington.

Cone and seed insects. The 1971 Douglas-fir cone crop west of the Cascade Mountains in Oregon and Washington was medium to heavy. The Douglas-fir scale midge, *Contarinia oregonensis* Foote, damage was light. Seed damaged by the Douglas-fir cone moth, *Barbara colfaxiana* (Kft.), ranged from 1 to 18 percent. Douglas-fir seed chalcid, *Megastigmus spermatrophus* Wachtl., losses averaged less than 3 percent of the viable seed.

Other insects. Ground surveys for European pine shoot moth, *Rhyacionia buoliana* (Schiff.), revealed one new infestation, which was controlled, in Pendleton, Oreg. Light populations were detected at Port of Umatilla and heavy populations at McNary Dam, Oreg. No new infestation centers were found in Washington. The California oakworm, *Phryganidia californica* Pack., caused moderate to heavy defoliation of chinquapin in several areas of Douglas and Lane Counties, Oreg.

A severe outbreak of several species of grasshoppers occurred in eastern Oregon, primarily on rangelands. Pine plantations located near these outbreaks were heavily defoliated. The principal species involved were the migratory grasshopper, *Melanoplus sanguinipes* (Fab.); the Packard grasshopper, *Melanoplus packardii* Scudd.; the clearwinged grasshopper, *Camnula pellucida* (Scudd.); and the Enigma, *Oedaleonotus enigma* Scudd.

The elm leaf beetle, *Pyrrhalta lutcola* (Muller), severely skeletonized the leaves of elm trees, causing premature leaf drop in several Oregon communities. The pine aphid, *Pineus coloradensis* Gill., caused minor defoliation in 1971 on lodgepole and ponderosa pines in eastern Oregon. Ground surveys for the western pine shoot borer, *Eucosma sonomana* Kearf., were made in several pine plantations in Oregon and Washington and revealed this pest to be widely distributed. Terminal and lateral damage apparently declined this year in Washington but increased in central and southern Oregon.



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This ponderosa pine twig has been mined by the western pine shoot borer *Eucosma sonomana*. The mined terminal is still alive but growth and needle length have been reduced (Yakima, Wash.).

The smaller European elm bark beetle, *Scolytus multistriatus* Marsh. Adults and larvae have been collected from trap elm logs placed at Hood River, Hood River County; Medford, Jackson County; and Grants Pass, Josephine County, by Oregon Department of Agriculture personnel. These are new county records in Oregon. The Medford and Grants Pass collections are particularly significant since they represent the first records documenting the occurrence of this insect west of the Cascades. Counties in eastern Oregon from

which collections have been made include Wasco, Umatilla, Malheur, Klamath, and Lake.

Status of Diseases

Dwarf mistletoe, *Arceuthobium* spp. Dwarf mistletoes continue to be a major cause of growth loss in the Pacific Northwest. The annual growth loss attributable to dwarf mistletoes has been estimated at 147 million cubic feet. In 1971 control activities were conducted on 10,000 acres. Control efforts are expected to increase as forest management becomes more intensive.

Verticicladiella root rot disease, caused by *Verticicladiella* sp., of Douglas-fir was found in plantations on the Olympic, Gifford Pinchot, and Snoqualmie National Forests in Washington and the Mount Hood, Siuslaw, Siskiyou, Umpqua, Willamette, and Wallowa-Whitman National Forests in Oregon during the summer of 1971. However, only a few trees per acre appear to be infected.

Bynum's blight. A foliage disease of offsite ponderosa pine, caused by the needle cast fungus, *Lophodermella morbida,* was found on 38 plantations in southwest Oregon. The geographical range of the disease extends from the Rigdon District on the Willamette National Forest to the Tiller District on the Umpqua National Forest. The disease, commonly referred to as Bynum's blight, was first detected in 1967. Seed from nonlocal sources was used in establishing these plantations, and most of the ponderosa pine is growing on sites better suited to other species.

Rhizina root rot, caused by *Rhizina undulata* Fr., has been associated with Douglas-fir seedling mortality on recently planted broadcast-burned sites in Washington. The Washington State Department of Natural Resources and the University of Washington are conducting a survey to determine the distribution of the disease.

Atropellis canker, caused by *Atropellis piniphila* (Wear) Lohment Cash, was found on nearly all lodgepole pine in three stands on the Joseph District of the Wallowa-Whitman National Forest, Oreg.

A leaf blotch of aspen leaves, caused by *Marssonina populi* (Lib.) Magn., has been observed over a large area on the Bureau of Land Management lands in Steen's Mountain Range in southeastern Oregon.

CALIFORNIA (R-5)

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Conditions in Brief

The Douglas-fir tussock moth has again demonstrated a nearly explosive ability to build up epidemic populations in California forests. During a brief period in August and September 1971, sizable areas of green fir forests were heavily defoliated by this pest. In some severely defoliated areas the populations have nearly collapsed without the usual high incidence of virus disease, whereas in low population areas there appears to be an increase in the infestations. The buildup of lodgepole needle miner in Yosemite National Park continued through the emergence of adult moths in August. Later surveys to investigate establishment of the new generation indicated that newly hatched larvae successfully invaded needles in large numbers. The increasing trend of lodgepole needle miner populations is expected to continue. The potentially damaging western pine tip moth was detected for the first time in California in 1971.

Bark beetle activity remained at a low level during the year in most areas. Continuing studies of bark beetle attractants for the survey and control of the western pine beetle produced promising results during 1971.

Several minor leaf, needle, and canker diseases were prevalent this year, presumably because of the wet and cool spring conditions. These diseases are not expected to persist at high incidence levels. Elytroderma needle blight continued to increase in severity in

several areas of the State while red band needle blight declined. Phloem necrosis of Douglas-fir, discovered in California in 1970, increased in incidence.

Foliage diseases caused severe damage to 1-0 Jeffrey and ponderosa pine and Douglas-fir seedlings at the Humboldt Nursery. Chemical control sprays were effective in controlling the disease-causing fungus. The white pine blister rust control program has been modified. Ribes eradication has been discontinued in California. Search for rust-resistant sugar pine was intensified and preliminary work that will lead to prescriptions for silvicultural control was begun.

Status of Insects

Douglas-fir tussock moth, *Hemerocampa pseudotsugata* McD. Infestations of the Douglas-fir tussock moth underwent a variety of conditions and trends during 1971. Extensive surveys of early larval stages conducted during the first half of July indicated continuing and increasing populations in the two large and more severe infestations. Insignificant or absent populations were indicated in all the other locations of known or suspected infestations. Severe defoliation occurred on two areas of approximately 1,300 and 2,500 acres. These two areas were undetected early in the year, one being found in August and the other in September.

In September a severe dieoff of mature larvae occurred in three of four heavily defoliated outbreak areas. Mumified larvae littered the ground, but laboratory examinations failed to indicate the cause of this widespread insect mortality. At the same time the fourth severe infestation was collapsing from a virus infection.

During the fall, new incipient infestations were also discovered at seven locations from Shasta County in the northern Sierra Mountains to Fresno County in the southern part of the range.

Egg mass sampling conducted during October indicated epidemic areas had declined to light populations. Areas of previously incipient infestations increased to light population levels.

In a field experiment in July 1971 the native tussock moth virus was applied by helicopter to two 60-acre plots in separate areas of increasing populations. So far, no effect of this biological control treatment is evident from detailed sampling of treated and untreated areas. In 1972 additional studies of both chemical and biological control agents may be conducted.

Lodgepole needle miner, *Coleotechnites milleri* (Busck.). In addition to the known locations of lodgepole needle miner outbreaks at Virginia Canyon and Conness Creek in Yosemite National Park, another outbreak area was discovered in Lyell Canyon. Also, an area of defoliated lodgepole pine was reported near Waugh Lake in Mono County. Increasing populations of the needle miner were surveyed in the important recreation forest at Tuolumne Meadows. The new generation of this 2-year life cycle insect began with the emergence of adult moths in August 1971, followed by mating and egg laying. Eggs of the new generation hatched and the first-stage larvae invaded their first needles in October. A substantially larger population of larvae were detected than was found in the same stage of the previous generation. Noticeable defoliation is expected in campgrounds and picnic areas around Tenaya Lake by 1973.

Western pine tip moth, *Rhyacionia bushnelli* Busck. The western pine tip moth was discovered for the first time in California on July 27, 1971, at Santee in San Diego County. Infested nursery stock imported from Michigan is believed to be the source of introduction. Surveys by the California Department of Agriculture have located infestations in the El Cajon Valley, San Diego County; Chino, San Bernardino County; and as far north as Wasco, Kern County. Fifteen nurseries have been identified as infested in San Diego County. The moth is considered to be too widespread to permit eradication. This moth, native to the Central Plains and Southwestern United States, is larger than species

native to California and considered a much more damaging pest.

Balsam fir sawfly, *Neodiprion abietis* (Harr.). Populations of the balsam fir sawfly again increased in 1971. Most of the increased activity occurred in Plumas, Lassen, and Modoc Counties. The damage reported near Belden and Portola, Plumas County, constitutes the most widespread and severe infestation that has occurred for several years. Winter or early spring surveys are planned to evaluate these infestations.

Miscellaneous defoliators. In a startling display of insect abundance, clouds of the California tortoiseshell butterfly, *Nymphalis californica* (Bdv.), were reported from much of northern California during early August. Near Mount Shasta the butterflies interfered with freeway traffic by plugging radiators and blocking vision. They were plentiful again in late September. The larvae feed mostly on *Ceanothus* brush and large populations developed in the extensive brush fields of the region. At least two, and probably three, generations of butterflies were produced during the 1971 season.

Hardwood defoliators which apparently declined in activity included the fruit-tree leaf roller, *Archips argyrospilus* (Wlk.); the fall webworm, *Hyphantria cunea* (Drury); and the California oakworm, *Phryganidia californica* Pack. The satin moth, *Stilpnotia salicis* (L.), increased its activity in the continuing outbreak northeast of Alturas in Modoc County.

Western pine beetle, *Dendroctonus brevicomis* LeC. Although infestations of the western pine beetle were reported from 25 locations in northern California, the continuing epidemic in the young pine stands of McCloud Flats, Siskiyou County, remains the only large and serious infestation.

In southern California, however, this beetle continues to cause high tree mortality at Lake Arrowhead and Barton Flats, San Bernardino County, where it is associated with serious air pollution damage on ponderosa pine. In addition, an upward trend is occurring where fires burned thousands of acres of timber in San Bernardino and San Diego Counties in the fall of 1970. The Forest Service is salvaging the fire-damaged timber in southern California on National Forest land where terrain is not too steep. The Corps of Engineers, through the Office of Emergency Preparedness, has contracted with private firms to clean up the fire-damaged timber on private land.

A large-scale field test was conducted in the McCloud Flats area to determine the effectiveness of synthetic attractants to suppress the western pine beetle and to survey in-flight beetle populations. As with the first test in 1970 at Bass Lake, Madera County, large numbers of beetles were trapped. Further evaluation of in-tree populations and overall tree mortality on the Bass Lake study area was conducted in 1971. Similar evaluations on the McCloud Flats study area will be continued the next 2 years. Data analysis and evaluation are so complex in these tests that the intrinsic effects of this trapping on the two infestations may not be known for some time.

Fir engraver beetle, *Scolytus ventralis* LeC. Tree killing by fir engravers accelerated in 1971. Losses were probably most severe and widespread on the Klamath National Forest, Siskiyou County, but were reported on most forested areas from El Dorado County north to the Oregon border. When possible, infested trees were removed by logging to suppress local buildups. Additional surveys are needed to investigate the trend of these infestations in 1972.

Mountain pine beetle, *Dendroctonus ponderosae* Hopk. This beetle continues to be closely associated with air pollution damage to ponderosa pine around Lake Arrowhead and with fire damage at Smiley Park in San Bernardino County. Limited chemical control was needed to destroy mountain pine beetle broods in the bark of infested lodgepole pine trees in the Wrights Lake recreation area, El Dorado County, and in the Silver Creek summer home tract, Placer County. The killing of scattered large sugar pine trees by this beetle was again becoming noticeable in the Sierra

F–521517

Forest Service technician checks survey trap used in bark beetle sex attractant (pheromones) study to develop survey and control techniques for western pine beetle (Shasta-Trinity National Forest, Calif.).

Range around Yosemite, Sequoia, and Kings Canyon National Parks.

Pine engraver beetles. The California five-spined ips, *Ips confusus* (LeC.), by breeding up large populations in storm-damaged trees, threatened valuable silvicultural research studies in the Elliot Range Plantation, Placer County. This threat was alleviated by spraying about 200 small infested trees with lindane. Fifty knobcone pine trees also were attacked and had to be sprayed with lindane to protect a special tree-breeding grove at the Institute of Forest Genetics near Placerville. This beetle also has been identified as the cause of widespread Monterey pine tree mortality in ornamental plantings in suburban cities east of San Francisco, Contra Costa County. In late summer and fall infestations of this beetle were reported developing on most of the timbered lands damaged by fire in southern California in 1970.

Another pine engraver, *I. pini* (Say), caused minor but threatening damage in the initial phases of a dwarf mistletoe control project on the Kern Plateau. A modified cutting schedule was recommended to better manage the ips population in this area.

Other bark beetles. The Jeffrey pine beetle, *Dendroctonus jeffreyi* Hopk., and California flatheaded borer, *Melanophila californica* Van Dyke, displayed increased activity in parts of southern California. The red turpentine beetle, *D. valens* LeC., was abundant in association with the western pine beetle epidemic at McCloud Flats. The Douglas-fir engraver, *Scolytus unispinosus* LeC., was found frequently associated with a recently discovered canker

disease, *Dermea pseudotsugae* Funk, of Douglas-fir.

Scale insects. The black pineleaf scale, *Nuculaspis californica* (Coleman), has been reported in several local areas, primarily damaging sugar pine. The most severe infestations were found around Mount Shasta and Dunsmuir in Siskiyou County where mature sugar pine displayed discolored, shortened, scale-encrusted foliage, which obviously placed the trees under severe stress. At Viola, Shasta County, a decline in scale damage was reported.

A pinyon needle scale, *Matsucoccus acalyptus* Herb., continues at a high population level on more than 22,000 acres in Ventura and Kern Counties. Entomologists at the University of California at Riverside are conducting research on the biology and natural enemies of this pest.

Insects damaging plantations and young trees. Infestations of the pine resin midge, *Cecidomyia piniinopis* O.S., have apparently declined in area and intensity although the insect is still quite common throughout California. In specific locations in the Mount Shasta area, however, the outbreak continues unabated and young pine plantations have been permanently damaged.

A native pine shoot moth, *Eucosma sonomana* Kearf., was found retarding height growth of pines in some plantations of the east side forests. This discovery follows earlier investigations of the same problem in eastern Oregon. Extensive work will be required to evaluate the impact of damage from this insect in California.

The fir coneworm, *Dioryctria abietella* (Grote), continues to infest the graft union on valuable seed orchard trees. Field studies are in progress to evaluate a mechanical barrier and an insecticide in preventing this damage.

Status of Diseases

Elytroderma needle blight, caused by *Elytroderma deformans* (Weir) Darker, continued to increase in incidence and severity in the State this year. The disease was especially severe along the south shore of Lake Tahoe from Camp Richardson to Emerald Bay and in the Butte Creek area of the Lassen National Forest. The death of many pole-sized trees in these areas has been attributed to this needle blight.

Red band needle blight, caused by *Scirrhia pini* Funk and Park and *Dothistroma pini* Hulb., was less damaging in 1971 than in recent years on the north coast of California. Only two new centers were found. The fungus is maintaining an endemic level in most areas having a previous history of the disease. Where *S. pini* has been active for a number of years, many trees have died or are dying. However, mingled among these trees are vigorous Monterey pines that have been able to maintain enough disease-free crown to continue substantial growth. The last 3 years' needles on many of these trees are free of the disease. There is a good chance that the trees will recover and grow out of the susceptible stage.

Phloem necrosis of Douglas-fir, *Dermea pseudotsugae* Funk. This fungus that causes stem and twig cankers on Douglas-fir was first discovered in California in 1970. The original discovery was in a Douglas-fir plantation near Happy Camp in Humboldt County. In 1971 it was found throughout Humboldt, Trinity, Siskiyou, and northwestern Mendocino Counties. Little is known about the behavior of the fungus and the magnitude of its threat to plantations and natural stands.

Verticicladiella root disease. Extensive damage caused by *Verticicladiella wagenerii* Kendrick has been reported in recent years from several areas in the region. The most noticeable of these are infections in ponderosa pine in the Shasta-Trinity National Forest, in ponderosa pine and Douglas-fir in the Eldorado National Forest, and in pinyon pine in the Inyo and San Bernardino National Forests.

The most extensive damage occurred in the San Bernardino National Forest where about 8,000 acres of pinyon pines are infected. Dead

and dying trees are located in centers, usually ½ to 1 acre in size but sometimes as large as 100 acres. The centers appear to be enlarging at an accelerating rate.

Root disease, *Fomes annosus* (Fr.) Cke. A survey made in Yosemite Valley to determine the extent of *F. annosus* revealed about 85 infection centers ranging in size from a few trees to several acres. Surveys will be made to determine the importance of this root disease as a cause of hazardous trees and a threat to the forest cover in the developed portions of the valley. The University of California, California Division of Forestry, and U.S. Forest Service are cooperating in this joint project.

White pine blister rust, *Cronartium ribicola* Fischer. Ribes eradication has been discontinued in California. The search for rust-resistant candidate trees was intensified and extended to new areas with promising results. Preliminary work that will lead to prescriptions for silvicultural control was begun. The direct control project in the southern Sierra Nevada was discontinued when results of scouting indicated that the disease is intensifying too rapidly in this zone to be contained by eradicating infection centers.

Nursery diseases. Two fungi caused significant losses at the Humboldt Nursery. *Sirococcus strobilinus* (Desm) Petr., caused a tip blight on 1-0 Jeffrey and ponderosa pine, killing many seedlings. A species of *Phoma* attacked the foliage of 1-0 Douglas-fir seedlings during the dormant season, causing severe defoliation usually resulting in death of the seedlings. Approximately 2 million seedlings were killed by this fungus in 1971.

Cooperative chemical control tests were carried out during 1970 and 1971 by the University of California Agricultural Extension Service, Pacific Southwest Forest and Range Experiment Station, and Region 5. Application of Deconil 2787 (75 percent chlorotholonil) at 2 lbs./100 gallons and Difolatan (39 percent captafol) at 1 qt./100 gallons resulted in excellent control of these fungi.

Air pollution damage. A survey made in 1969 covering 161,000 acres on the San Bernardino National Forest indicated that trees on 29 percent of the area were severely affected. The major species affected were ponderosa and Jeffrey pine. In total, 1.3 million trees were affected to some extent, 3 percent were dead, 15 percent were severely affected, and 82 percent were moderately or lightly affected. Recent studies at Lake Arrowhead indicate that ponderosa pine mortality is occurring at the rate of 3 percent per year.

On the Angeles National Forest a similar survey in the ponderosa-Jeffrey pine type was made in 1970. Trees on 3,300 acres were severely affected, those on 13,200 acres were moderately affected, and those on 23,700 acres were lightly affected. Recent observations indicate that damage is increasing, particularly along the Angeles Crest Highway.

F–521519

Smog damage to ponderosa pine on San Bernardino National Forest. Note difference in susceptibility of individual trees to oxidant air pollutants.

INTERMOUNTAIN STATES (R–4)[1]

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Conditions in Brief

Bark beetles were the most damaging forest insects in the Intermountain States during 1971. Although the mountain pine beetle population is at its lowest level in several years, large-scale tree killing continues in some areas. The most severe outbreak is in the Warm River area of the Targhee National Forest and the southwest portion of Yellowstone National Park. The chronic Douglas-fir beetle infestation in southern Idaho is waning. Storm damage triggered a widespread outbreak of the spruce beetle in north-central Utah. A low but important roundheaded pine beetle infestation continues to kill ponderosa pine in high-use areas near Las Vegas, Nev.

Defoliators were active again in 1971. Western spruce budworm infestation boundaries widened slightly on the Payette and Boise National Forests but decreased on the Bridger National Forest. Defoliation increased in both infestations but tree killing did not occur. A polyhedrosis virus is suspected of reducing populations of the Douglas-fir tussock moth in southern Idaho. A variety of other forest and range insects were of local concern in other parts of the region.

Dwarf mistletoe is the most important disease in Region 4. This disease is responsible for killing an estimated 135 million board feet of timber annually. Annosus root rot fungus was common throughout the region but most of the infections were of minor importance.

Although air pollution currently is not causing serious problems in the forests of the region, plots are being established to determine background levels of sulfur dioxide. These levels will be compared to future levels near electric generating plants now under construction.

[1] Includes forested lands in Utah, southern Idaho, western Wyoming, and Nevada.

Status of Insects

Mountain pine beetle, *Dendroctonus ponderosae* Hopk., in lodgepole pine continues as the number one forest insect problem in the region. The outbreak impact will be felt far into the future. The problem now is not so much the beetle, for it continues its decline, but rather the overwhelming task of managing the seriously depleted lodgepole forests. Low timber volumes, increased fire hazard, depleted recreation sites, increased road and trail maintenance, and the beetle's long-term effect on other less tangible resource values now confront the land manager.

On a regional scale, tree killing continues but is well under the extreme level which persisted for so many years. The most serious outbreak is on the Targhee National Forest, Idaho, where beetle populations are increasing after termination of a sustained control effort. Control was undertaken to reduce tree losses and permit salvage of some of the most heavily infested stands and to protect timber values in stands ultimately threatened. The project was finally terminated in 1971 for several reasons: (1) the scope and intensity of the infestation, (2) the relatively short-lived effects of individual tree control, (3) the additional cost of incorporating environmental safeguards into the treatment method, and (4) the relatively small volume of timber that could be saved through harvesting. The infestations in this area continue at an epidemic level. To the south, the once damaging infestation has run its course; to the east, in Yellowstone National Park, the epidemic is rampant. In adjoining Grand Teton National Park, the once heavy infestation continues to decline. Widely scattered tree killing of varying intensities occurs throughout parts of the Sawtooth and Caribou National Forests, Idaho; Teton and Bridger National Forests, Wyo.; Cache National Forest, Idaho and Utah; and the Ashley and Wasatch National Forests, Utah.

Killing of ponderosa pine by the mountain pine beetle continues in widely separated areas on the Ashley National Forest and Bryce Canyon National Park, Utah, and on State and private lands near Cascade, Idaho. The moun-

ain pine beetle population is expected to decline in all areas except on the Ashley National Forest.

Douglas-fir beetle, *Dendroctonus pseudotsugae* Hopk. The once severe Douglas-fir beetle infestations in southern Idaho have leveled off in some areas and declined in others. Decreases in both the number and size of dead tree groups were recorded on the Boise and Sawtooth National Forests. A significant decline in beetle populations occurred in Hat Creek and the South Fork of Iron Creek, Salmon National Forest. Salvage of the infested and dead timber was undertaken wherever practical, but the overall decline in standing tree attacks is attributed to a reduction in storm damage during the past few winters.

Spruce beetle, *Dendroctonus rufipennis* (Kby.). Accumulations of windthrown trees and other storm-caused debris during the past 2 years nurtured aggressive spruce beetle populations in portions of north-central Utah. Significant tree losses have occurred in the high elevation spruce stands of the Uinta, Manti-LaSal (Manti Division), and Fishlake National Forests. An aggressive and timely trap tree program to divert emerging beetles from attacking standing spruce is in progress on the Beaver District, Fishlake National Forest. Early winter storms precluded complete fall treatment of infested trees in Race Track Creek, Uinta National Forest. Control with ethylene dibromide will continue in the spring of 1972, before beetle flight.

Roundheaded pine beetle, *Dendroctonus adjunctus* Blandf., populations are still active in mature and overmature ponderosa pine stands on the Las Vegas Ranger District, Toiyabe National Forest, Nev. Aerial observers reported a decline in overall tree mortality, but some tree killing is still occurring in recreation sites and in a summer home area. Attempts have been made to minimize local buildups by felling and removing or treating infested trees.

Western spruce budworm, *Choristoneura occidentalis* Free., populations are considerably lower than previous high levels, but potential infestation centers remain. The largest outbreak covers 250,000 acres and is scattered throughout the Douglas-fir, true fir stands of the Payette and Boise National Forests in southern Idaho. Infestation boundaries increased only slightly from those recorded in 1970, but defoliation intensity increased significantly. Heavy defoliation was visible throughout the scenic area surrounding Payette Lake, McCall, Idaho. On the Bridger National Forest, Wyo., total infested acreage was half that recorded in 1970, but feeding damage intensified. This outbreak extends onto adjoining portions of the Targhee and Teton National Forests. Egg mass evaluation data indicate a slight increase in budworm levels in both the Payette and Bridger infestations in 1972.

Douglas-fir tussock moth, *Hemerocampa pseudotsugata* McD. The longstanding infesta-

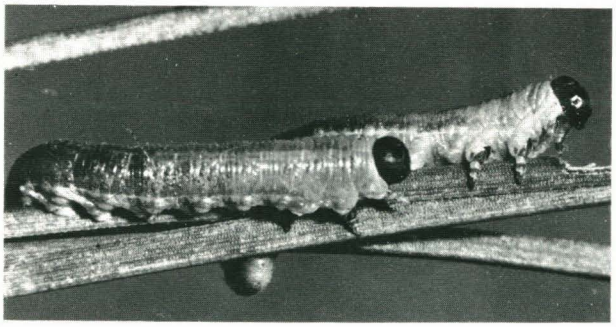
F-503791

Mature larva of the Douglas-fir tussock moth.

tion on Bureau of Land Management, State, and private lands in Owyhee County, Idaho, has exhibited significant year-to-year fluctuations. The population was at a low level in 1969 but increased rapidly during 1970 and 1971, causing moderate to heavy defoliation of Douglas-fir in some areas. Heavy larval mortality by a polyhedrosis virus was evident this summer and the effects of this disease may reduce tussock moth populations to a low level during the 1972 season.

Western tussock moth, *Hemerocampa vetusta* (Boisduval), defoliation increased on both *Ceanothus* sp. and ponderosa pine in the Town Creek Plantation, Boise National Forest. Feeding is normally confined to *Ceanothus* but when populations are high and competition for food increases larvae migrate to nearby planted pine and resume feeding. Heavier than normal egg deposition on *Ceanothus,* and to a lesser extent on ponderosa pine, indicates even greater activity in 1972.

Pine butterfly, *Neophasia menapia* (Feld. & Feld.), flights have increased the past 2 years with noticeable defoliation of ponderosa pine occurring along the Salmon River, Payette National Forest, and in parts of the Boise National Forest. The future status of this defoliator is unknown.



F–521517

Larvae of the sawfly *Neodiprion fulviceps* feeding on ponderosa pine needles (Fishlake National Forest, Utah).

A sawfly, *Neodiprion fulviceps* (Cresson), heavily defoliated an isolated stand of ponderosa pine for the second straight year in Clear Creek, Fishlake National Forest, Utah. The larval population was reduced by an infectious pathogen that is yet unidentified. The trend of this sawfly will be determined from egg deposition data collected during a late 1971 survey.

A leaf miner, *Argyresthia* sp. This minute defoliator, aided by a physiological decline in tree vigor, heavily defoliated incense cedar along the southeast shore of Lake Tahoe, Nev. Low overwintering larval populations indicate a decrease in defoliation in 1972.

F–521515

Terminal shoot of this lodgepole pine was killed by the weevil *Pissodes terminalis,* causing reduced height growth and development of a forked top (Nasatch National Forest, Utah).

Pinyon needle scale, *Matsucoccus acalyptus* Herb., populations remained at a high level for the second straight year in widely separated

areas of southern Utah and Nevada. Damage to pinyon pine Christmas trees was particularly severe in localized areas on the Humboldt and Toiyabe National Forests. In some areas Christmas tree production and sales may be seriously affected. The effect of the scale on cone production is uncertain. Control is not planned.

Cone and seed insects. An extensive survey was made in 1971 of various coniferous cone crops in forested areas of southern Idaho to identify and evaluate insect activity. Cone crops were exceptionally heavy, therefore damage resulting from insects was relatively light. A tentative list of the most damaging insects by tree species follows: ponderosa pine, *Laspeyresia* spp.; Douglas-fir, *Barbara colfaxiana* (Kft.); Engelmann spruce, *Laspeyresia youngana* (Kft.); grand fir, unidentified Diptera (possibly *Earomyia* sp.); lodgepole pine, unidentified Lepidoptera; subalpine fir, unidentified Diptera (possibly *Earomyia* sp.); and limber pine, *Dioryctria* sp.

Other insects. Natural factors and a minimum of logging debris have kept the usually aggressive pine engraver, *Ips pini* (Say), at a tolerable level. The lodgepole terminal weevil, *Pissodes terminalis* Hopp., continues to kill terminal leaders of lodgepole pine reproduction in widely separated areas of the region. Natural factors caused a significant decrease in populations of a leaf blotch miner, *Lithocolletis* sp. near *salicivovella* Braun, on Fremont cottonwood in Zion National Park. The sugar pine tortrix, *Choristoneura lambertiana* (Busck.), a defoliator of lodgepole pine, remains at an endemic level for the second straight year. *Lambdina punctata* (Hulst.), a defoliator of gambel oak along the Wasatch Front, dropped to a very low level. *Archips negundanus* Dyar caused extensive defoliation of boxelder in parts of northern Utah and southern Idaho. The pine needle sheath miner, *Zelleria haimbachi* Busck., defoliated pole-sized ponderosa pines near Monticello, Utah.

Status of Diseases

Air pollution. Plots were established in 1971 to determine background SO_2 levels and vegetation characteristics prior to the construction of the Navajo Generating Station at Page, Ariz. Results of this study will serve as a base for determining the station's impact on vegetation in the area.

In the spring of 1971 sulfation plate locations and vegetation study plots were established on the Glen Canyon National Recreation Area and Bureau of Land Management lands north of the recreation area. Analysis of sulfation plates exposed for two 2-month periods indicates a nondetectable background level of SO_2 at present. Examination of succulent vegetation at the end of May 1971 revealed no symptoms that could be described as SO_2 damage. Laboratory and field fumigations of desert vegetation have been done and results will be published by the University of Utah.

Dwarf mistletoe, *Arceuthobium* spp., is the most important forest disease in the Intermountain Region. Regional losses through growth reduction and mortality due to this parasitic plant conservatively are estimated at 135 million board feet per year. Timber sales and silvicultural operations properly carried out are the most effective means of control. However, large acreages of past selectively logged sales are a severe problem. Typically, these stands have a scattered noncommercial infected overstory and now support excellent stands of advanced regeneration which are jeopardized by the infected overstory. Most of the acreage affected is lodgepole pine type, with a lesser acreage of Douglas-fir type.

Annosus root rot, *Fomes annosus* (Fr.) Cke. Over the last 6 years *F. annosus* root rot has been found actively killing trees, from seedlings to sawlog size, in 35 locations in the Intermountain Region. Significant damage has been found in only five of these infection centers. Most susceptible species are apparently subalpine fir, *Abies lasiocarpa,* ponderosa pine, and Jeffrey pine. All infection centers were found in areas where stumps were left from timber-cutting operations with the exception of a series of centers spotted from the air along the Wasatch Front. These centers, in

areas with a history of strong wind and snow avalanche activity, have never had any history of cutting. Infection courts in these areas are created by wind- and snow-broken stems and roots.

The needle cast fungus, *Elytrodermra deformans* (Weir), caused severe infection of lodgepole pine stands growing in stream bottoms in central Idaho. Infection intensity decreased and then disappeared with increases in elevation out of the stream bottoms. Around Cascade, Idaho, both ponderosa and lodgepole pine were infected. Again infection was confined to the lower elevations and disappeared on the uplands.

NORTHERN ROCKY MOUNTAINS (R–1)[2]

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Conditions in Brief

Western spruce budworm damaged 4.1 million acres of Douglas-fir, spruce, and true fir forests in western Montana and northern Idaho. Infestations continued to increase and spread northward in forested areas west of the Continental Divide. Defoliation also increased in intensity in several areas east of the Continental Divide where populations have been on a downward trend for several years. The larch casebearer completed its invasion of the western larch type in the region—all stands are now infested. Heavy larch casebearer defoliation occurred at the lower elevations in northeastern Washington and northern Idaho.

[2] Includes forested lands in Montana, northeastern Washington, northern Idaho, North Dakota, and northwestern South Dakota and National Park Service land in northwestern Wyoming.

Mountain pine beetle infestations continued in western white pine stands on the Kaniksu and Flathead National Forests and new infestations were detected on the Colville National Forest in Washington. The massive mountain pine beetle infestation in lodgepole pine stands in Yellowstone National Park, Wyo., spread northward and caused extensive tree mortality. Infestations continued on the Gallatin and Lolo National Forests in Montana. Activity by the Douglas-fir beetle increased significantly with a massive infestation occurring on lands of mixed ownership in the North Fork Clearwater River Drainage in Idaho. Pine engraver infestations occur in ponderosa pine stands near Missoula, Mont. Spruce beetle and fir engraver populations continued to decline.

The Douglas-fir tussock moth defoliated shade trees in residential areas of Coeur d'Alene, Idaho, and is apparently building up in several parts of the region. The pine butterfly caused noticeable feeding damage on the Nezperce National Forest, Idaho, and on the Bitterroot National Forest in Montana. Infestations are expected to increase in 1972. A 2-year-old infestation of pine looper collapsed due to disease, but new areas of defoliation were detected in southeastern Montana. The variable oak leaf caterpillar and the forest tent caterpillar defoliated hardwood forests in North Dakota.

Nursery diseases continue to cause problems. Root diseases are a potentially dangerous hazard to timber production. Heartrots are a significant problem. Stem cankers and galls are causing growth loss in young stands. Dwarf mistletoes are still the most important disease within the region. Needle cast diseases were widespread and abundant on true firs and two- and three-needle pines. Needle rusts were abundant on true firs, but actual damage was slight. Air pollution caused injury to vegetation in the Columbia Falls, Mont., area.

F–521535

Time-share computer systems are used extensively in the Northern Rockies to facilitate rapid and timely processing of survey and evaluation data.

Status of Insects

Western spruce budworm, *Choristoneura occidentalis* Free. The longstanding western spruce budworm infestation in the Northern Rocky Mountains continued at approximately the same level as in previous years. In total, 4,137,800 acres of Douglas-fir, spruce, and true fir forests were damaged by this insect in 1971. The intensity and acreage of infestation increased on several forests west of the Continental Divide in western Montana and northern Idaho. Some 1.3 million acres were damaged on the Nezperce National Forest, the highest for any forest in the region. Epicenters of defoliation enlarged on the Clearwater and St. Joe National Forests in Idaho. Western spruce budworm defoliation increased considerably on the Flathead Indian Reservation and the Lolo and Flathead National Forests in Montana. The area of infestation spread northward in Montana with isolated pockets of damage occurring on subalpine fir north of Hungry Horse Reservoir on the Flathead National Forest. Infestations continued to decline on the Bitterroot National Forest, where only 175,000 acres of noticeable defoliation occurred in 1971.

In recent years the region has experienced a gradual decline of western spruce budworm defoliation in Douglas-fir forests east of the Continental Divide. This trend was broken in 1971 when an increase in defoliation intensity was detected on portions of the Gallatin and Helena National Forests and Yellowstone National Park.

The western spruce budworm continued to

be a serious pest of Douglas-fir cone crops in Montana. Budworm infestation in cones reduced the amount of seed available for natural regeneration in many areas east of the Continental Divide.

Larch casebearer, *Coleophora laricella* (Hbn.). The larch casebearer continued its spread throughout the western larch forests of western Montana and northern Idaho and invaded the few remaining uninfested stands in the North Fork of the Flathead River and Glacier National Park in 1971. All of the western larch type in the region is now considered infested.

Infestations intensified in northern Idaho after a decline of several years. Most western larch stands at lower elevations on the Kaniksu, Coeur d'Alene, and St. Joe National Forests suffered moderate to heavy feeding injury. Heavy defoliation also occurred on the Colville National Forest in northeastern Washington. Infestations remained at low levels in Montana with most larch stands suffering light to negligible defoliation except in the vicinity of Flathead Lake and along the Idaho border where moderate levels of feeding injury occurred.

Evaluations of native and introduced parasites of the larch casebearer continued in 1971. In addition to the introduced *Agathis pumila* (Ratz.), a total of 19 species of hymenopterous parasites have been recovered and identified. The most commonly occurring are *Dicladocerus* sp. near *westwoodii* Westwood and *Spilochalcis albifrons* (Walsh).

Mountain pine beetle, *Dendroctonus ponderosae* Hopk. A longstanding infestation of the mountain pine beetle continued in overmature western white pine stands in Lightning Creek on the Kaniksu National Forest, Idaho. Many trees killed by the beetle were removed by commercial timber sales. Two localized mountain pine beetle infestations in western white pine were detected on the Colville National Forest in Washington: One is located in the South Fork Salmon River and the other occurs in Gypsy Creek. Mountain pine beetle infestations continued in overmature western white pine near Hungry Horse Reservoir on the Flathead National Forest, Mont., but at lower levels than in 1970.

The perimeter of mountain pine beetle infestations in Yellowstone National Park spread significantly to the north and crossed the Madison and the Pitchstone Plateau, an area of open-grown whitebark pine. Ground surveys conducted by National Park Service personnel indicate that an average of 35.8 lodgepole pines per acre were attacked by mountain pine beetle in 1971 in the infested area, with some stands sustaining a loss of up to 63 trees per acre.

Heavy losses continued for the second year in lodgepole pine stands on the Squaw Creek District of the Gallatin National Forest, in spite of control efforts which consisted of cutting and burning infested trees. In addition, a heavy infestation was discovered in lodgepole pine stands on the Hebgen Lake District of the Gallatin National Forest near West Yellowstone, Mont.

Removal of infested trees by commercial sales and piling and burning resulted in a significant decline of mountain pine beetle infestations in mixed ponderosa-lodgepole stands on the Lincoln District of the Helena National Forest, Mont. Mountain pine beetle activity continued in three areas on the Lolo National Forest in western Montana in 1971: in second-growth ponderosa pine stands in Hayes Creek on the Missoula District; in Ninemile Creek on the Nine Mile District; and in lodgepole pine stands near St. Regis, Mont., on the Superior District where this insect is closely associated with the pine engraver *Ips pini* (Say).

Infestations of a small magnitude were scattered throughout the region. Those worthy of mention include infestations in lodgepole pine stands west of the Continental Divide in Glacier National Park and in ponderosa pine stands on private lands near Polson, Missoula, and Helena, Mont.

Douglas-fir beetle, *Dendroctonus pseudotsugae* Hopk. Douglas-fir beetle infestations were detected in several locations in the Northern Rocky Mountains. The most severe infestation occurred in Idaho on lands of mixed

ownership in the North Fork Clearwater River where large group kills occurred in mature and overmature Douglas-fir stands over a gross area of 288,000 acres. A cooperative aerial photo-ground survey revealed that 34 million board feet of Douglas-fir sawtimber was destroyed by this insect in 1970, and an additional 51 million board feet was killed in 1971. A coordinated salvage effort involving the Forest Service and other Federal agencies, the Idaho Department of Public Lands, and private industry is currently underway.

Significant Douglas-fir beetle activity also occurred in portions of the South Fork Clearwater River on the Nezperce National Forest and the St. Joe River on the St. Joe National Forest in Idaho and in several drainages near St. Regis, Mont., on the Lolo National Forest.

Spruce beetle, *Dendroctonus rufipennis* (Kby.). Spruce beetle infestations remained at low levels throughout the region for the third consecutive year. Populations were confined to windthrown timber in localized areas on the Colville National Forest, Wash., and the Stillwater State Forest in Montana. Brood development in windthrow was poor, indicating a low potential for activity in 1972.

Pine engraver, *Ips pini* (Say). Infestations on the Lolo National Forest, Mont., and adjoining State and private lands along the Clark Fork River continued in 1971. In addition, localized group kills caused by pine engraver occurred in ponderosa pine stands on Blue Mountain, a portion of the Lolo National Forest south of Missoula. These infestations extended southward into low elevation ponderosa pine stands in the Bitterroot Valley. The mountain pine beetle and western pine beetle, *Dendroctonus brevicomis* LeC., were frequent secondary invaders in trees top killed by the pine engraver.

Pine engraver beetles invaded lodgepole pine trees that were windthrown by a severe storm that occurred in June 1970 on the Hebgen Lake District, Gallatin National Forest. Brood emerging from windthrown material killed a small number of standing trees near West Yellowstone, Mont.

F–521534

Entomologist and forester examine a Douglas-fir infested by the Douglas-fir beetle (Clearwater National Forest, Idaho).

Engraver beetle damage was extensive in thinned stands, logged-over areas, and looper-defoliated ponderosa pine stands on the Northern Cheyenne Indian Reservation in southeastern Montana.

Douglas-fir tussock moth, *Hemerocampa pseudotsugata* McD., caused moderate to heavy defoliation of shade trees in residential areas in Coeur d'Alene, Idaho. None of the surrounding forested areas was infested, however. Localized defoliation of individual shade trees also occurred in Spokane, Wash., and Polson and Missoula, Mont., for the second consecutive year. Increased activity by this serious forest defoliator is expected next year.

Pine butterfly, *Neophasia menapia* (Feld. & Feld.), increased notably throughout the

region. Defoliation occurred on a number of separate areas totaling 4,600 acres of ponderosa pine stands on the Bitterroot National Forest and adjoining private lands in western Montana. An additional 4,200 acres of ponderosa pine suffered heavy defoliation along the Salmon River, Nezperce National Forest, Idaho. Flights of adult butterflies were reported from numerous locations including residential areas in Spokane, Wash.; Elk City, Idaho; and Missoula and Lincoln, Mont. Egg mass surveys on the Bitterroot National Forest indicate that an increase in pine butterfly activity can be expected in 1972.

A pine looper, *Phaeoura mexicanaria* (Grote). As predicted, the pine looper outbreak on the Ashland District of the Custer National Forest, Mont., and the adjoining Northern Cheyenne Indian Reservation collapsed due to disease infection following 2 years of heavy defoliation. Many of the defoliated trees are showing signs of recovery, although severely damaged trees have been attacked and killed by the six-spined engraver beetle, *Ips calligraphus* (Germ.).

New areas of pine looper defoliation were detected in the Ekalaka Hills and Long Pine Mountains, Sioux District, Custer National Forest, in the extreme southeastern corner of Montana. Approximately 15,000 acres suffered noticeable defoliation, although heavy larval mortality due to a bacterial disease had already exterted a significant impact on this outbreak.

Variable oak leaf caterpillar, *Heterocampa manteo* (Dbldy.), caused heavy defoliation of hardwoods in three separate areas of North Dakota. Bur oak and paper birch were defoliated on 2,760 acres in the Killdeer Mountains and 1,520 acres in the Saddle Buttes area of west-central North Dakota. An additional 1,750 acres were heavily defoliated near Devil's Lake. This included 900 acres of private lands along the lake's southwestern shore and 850 acres on the Sully's Hill National Game Preserve, Fort Totten Indian Reservation, and intermingled private lands. American basswood was the preferred host with other hardwoods also receiving noticeable damage.

Forest tent caterpillar, *Malacosoma disstria* Hbn., infested mixed hardwood stands near Devil's Lake, N.Dak., and caused light feeding damage. Infestation levels were down from 1970, and a large proportion of the larvae were infected by a fungus, *Entomophthora* sp., and nuclear polyhedrosis virus.

Other insects. Engelmann spruce weevil, *Pissodes strobi* (Peck) (= *engelmanni* Hopk.), damaged both natural and planted spruce regeneration in many parts of the region. Notable damage occurred in Emery Creek on the Flathead National Forest, Mont., and in a spruce plantation on the Nezperce National Forest, Idaho. A sawfly, *Neodiprion* sp., caused some localized feeding injury on lodgepole pine near Holland Lake, Flathead National Forest, and Lake Mary Ronan in Montana. Fir engraver, *Scolytus ventralis* LeC., infestations continued to decline. Some new attacks in grand fir occurred on the Coeur d'Alene and St. Joe National Forests, and on the Flathead National Forest it was associated with another fir beetle, *Pityokteines minutus* (Swain), in subalpine fir. The spring cankerworm, *Paleacrita vernata* (Peck), defoliated shelterbelt trees in North Dakota. Birch skeletonizer, *Bucculatrix canadensisella* Chamb., defoliated paper birch at Lake Metagoshe in the Turtle Mountains, N.Dak., and near Sandpoint, Idaho.

Status of Diseases

Root diseases. *Armillaria mellea* (Vahl ex Fr.) Kummer was endemic in most forested areas in the Northern Region during 1971. Severity varied from single-tree mortality to areas of mortality more than 30 acres in size. *Poria weirii* Murr. infected Douglas-fir, grand fir, western redcedar, and ponderosa pine on the Coeur d'Alene, Kaniksu, and St. Joe National Forests. Annosus root rot, caused by *Fomes annosus* (Fr.) Cke., infected young ponderosa pine plantations on the Colville National Forest and occurred in mature subalpine fir on the Coeur d'Alene National Forest. *Polyporus schweinitzii* Fr. occurred in Douglas-fir, grand fir, western hemlock, and western white pine on west side forests in the region.

Verticicladiella wagenerii Kendrick has been found in eastern white pine and lodgepole pine in several eastern white pine plantations on the Kootenai National Forest. The disease was apparently introduced on the eastern white pine planting stock. This root disease has been found only in these areas. *Polyporus tomentosus* Fr. sporophores were found on the Coeur d'Alene National Forest. The fungus was recovered from ponderosa pine on the Flathead Indian Reservation, but sporophores were not found on the reservation.

F-521529

The root rot fungus *Poria weirii* caused the mortality that created this opening about one-half acre in size (Coeur d'Alene National Forest, Idaho).

Stem diseases. *Fomes pini* (Thore ex Fr.) Karst. is common and attacks all coniferous species except western redcedar. *Echinodontium tinctorium* (E. & E.) E. & E. is still a problem in mature and overmature grand fir and western hemlock stands and causes a high degree of cull. Other stem-decaying organisms of importance are *Stereum sanguinolentum* (Alb. and Schw. ex Fr.) Fr., *Polyporus sericeomollis* Rom., *Hydnum abietis* Hubert, and *Fomes officinalis* (Vill.) Faull.

Cankers and galls. *Atropellis piniphila* (Weir) Lohman and Cash commonly was found causing branch and bole cankers on ponderosa pine and lodgepole pine in Montana. *Atropellis pinicola* Yeller and Gooding was found causing branch cankers on western white pine in northern Idaho. *Cronartium ribicola* Fisch. continued to be a limiting factor in western white pine management. Mortality is nearly 90 percent in some areas. *Peridermium harknessii* J. P. Moore is common on lodgepole

F-521530

Rhizomorphs of the root disease fungus *Armillaria mellea* on basal trunk of an infected tree.

F-521532

A comandra blister rust canker on stem of a young lodgepole pine (Montana).

pine and ponderosa pine throughout the region. *Cronartium comandrae* Pk. was locally heavy on lodgepole pine but was found infrequently on ponderosa pine.

Dwarf mistletoe, *Arceuthobium* spp. The dwarf mistletoes continued to be the most important disease organisms in the region. Control was proposed on 22,134 acres, but only 7,058 acres on 11 National Forests were treated. Three crossover infections of the lodgepole pine dwarf mistletoe *A. americanum* Nutt. ex Engel. were found on whitebark pine on the Gallatin National Forest.

Needle cast diseases. Four species of fungi caused significant needle cast disease in 1971. *Lophodermella concolor* (Dearn.) Darker was locally heavy on lodgepole pine on east side forests. *Lirula abietis concoloris* (Mayr. ex Dearn.) Darker was common on subalpine fir, particularly on west side forests. *Elytroderma deformans* (Weir) Darker was prevalent on ponderosa pine in the Flathead and Bitterroot Valleys. *Lophodermium pinastri* (Schrade. ex Hook) Chev. occurred on western larch in the Lookout Pass area of the Coeur d'Alene National Forest and on ponderosa pine, St. Joe National Forest.

Needle rusts. *Pucciniastrum goeppertianum* (Kuehn.) Kleb., was frequently found on subalpine fir on east side forests. *Melampsorella caryophyllacearum* Schroet. brooms were

F–521531

Control of dwarf mistletoe in lodgepole pine, Gallatin National Forest, Mont. Note infected uncut stand, buffer zone, and noninfected new regeneration in foreground.

abundant on subalpine fir at higher elevations. Brooms were found on grand fir at lower elevations on the Coeur d'Alene National Forest.

Air pollution. An intensive evaluation of injury to vegetation caused by airborne fluorides at Columbia Falls, Mont., was completed in November 1971. Abnormally high levels of fluorides were found in vegetation on more than 200,000 acres of State, private, National Park, and National Forest lands.

CENTRAL ROCKY MOUNTAINS (R–2)[3]

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Conditions in Brief

The spruce beetle and mountain pine beetle remained the most important insect pests in the Central Rocky Mountains. The spruce beetle has been very active on the Medicine Bow and Gunnison National Forests. The spruce beetle infestation decreased on the San Juan National Forest, but timber windthrown late in the year poses a new threat. The mountain pine beetle infested more than 200,000 ponderosa pine trees on the Black Hills National Forest in South Dakota and Roosevelt National Forest in Colorado and adjacent private lands. This insect also killed more than 150,000 lodgepole pine on the Medicine Bow, Routt, and Arapaho National Forests and adjacent State and Bureau of Land Management lands. Also included in this estimate are Bureau of Land Management lands in northwestern Colorado.

Defoliation by the western spruce budworm increased. The lodgepole terminal weevil caused terminal damage to sapling stands of lodgepole pine on the Routt and Roosevelt National Forests.

Dwarf mistletoe of lodgepole pine continues to be the most widespread and destructive

[3] Includes forested lands in Colorado, Kansas, Nebraska, South Dakota, and eastern Wyoming.

disease in the region. Removal of infected residual trees, which eliminates a major source of infection to the understory, was practiced on more than 1,500 acres in Colorado and Wyoming. The combination of dwarf mistletoe and comandra blister rust on lodgepole pine in some parts of the Shoshone National Forest in Wyoming may be a serious limiting factor in the management of that species. Top kill and tree mortality from the rust is common in pole and mature stands.

Shoestring root rot caused by *Armillaria mellea* is a common but not serious disease in lodgepole pine less than 25 years old in Colorado. The impact of this disease on lodgepole pine management is not known.

Canker diseases and heartrot caused considerable loss in quaking aspen stands in Colorado. Both diseases are more prevalent in stands more than 100 years old and on the poorer sites. Shorter rotations and prevention of wounds are two practices that will reduce losses from both diseases.

A Dutch elm disease control program was initiated at the Bessey Nursery of the Nebraska National Forest in central Nebraska to protect valuable shade trees until they can be replaced.

Status of Insects

Spruce beetle, *Dendroctonus rufipennis* (Kby.), caused excessive volume losses of mature and overmature spruce on three National Forests and minor outbreaks on five other National Forests. The spruce beetle outbreaks on the San Juan National Forest decreased due to a combination of cold weather, a dry summer, and aggressive woodpecker activity, in addition to logging and trap tree programs. Scattered fall windstorms on the San Juan and Rio Grande National Forests resulted in windthrown timber, thus increasing available host material.

One spruce beetle outbreak diminished on the Medicine Bow National Forest, but another outbreak killed about 15,000 trees in a mostly unroaded area. On the Gunnison National Forest, the West Elk Wilderness area and adjacent land have an outbreak (about 10,000 trees) for which no control is planned. Trap tree and logging programs were used to suppress another outbreak on the Gunnison National Forest. A spruce beetle infestation on the Bighorn National Forest is mostly within a new timber sale area. The Rio Grande and Grand Mesa-Uncompahgre National Forests each have potential problems in timber sale areas where trees felled for 1 or more years have become infested. The removal of these trees or felling of trap trees is planned for these areas.

Overall, the region's spruce beetle infestations appear to be static to decreasing. The amount of windthrow caused by winter and spring storms will be an important factor affecting the spruce beetle situation in Region 2 during 1972.

Mountain pine beetle, *Dendroctonus ponderosae* Hopk., remains a serious tree killer in overstocked and stagnated second-growth and mature ponderosa pine stands. The current outbreak in the Black Hills National Forest and adjacent private, State, and other Federal lands in both South Dakota and Wyoming was first reported in 1967. Losses in 1971 in the Black Hills were estimated at 274,500 trees or 21 million board feet of lumber.

Ponderosa pine stands along the Colorado Front Range continue to support mountain pine beetle infestations from Colorado Springs to the Wyoming border. These are primarily overmature and overstocked stands growing on relatively poor sites, and losses are often associated with conditions marginal for tree growth. An estimated 30,000 currently infested trees occur along the Front Range north of Denver. This includes a portion of the Pike and Roosevelt National Forests and intermingled and adjacent State and private lands.

Mountain pine beetle increased in lodgepole pine stands near Granby, Hot Sulphur Springs, and Rand in Colorado and near Encampment, Wyo. A persistent but somewhat sluggish infestation of mountain pine beetle remains active in lodgepole and limber pine near the old townsites of South Pass City and Atlantic City, Wyo., on private, Bureau of Land Management, and Shoshone National Forest lands.

Douglas-fir beetle, *Dendroctonus pseudotsugae* Hopk., continues to kill Douglas-fir in scattered patches, primarily in stands on rough, rocky terrain in Colorado and Wyoming. Limited logging has been the only control action on these infestation centers.

Western spruce budworm, *Choristoneura occidentalis* Free., defoliation on the San Isabel National Forest increased from 32,000 acres in 1970 to 113,000 acres in 1971. Sampling during 1971 indicates that, at the most, moderate (35 to 65 percent) defoliation can be expected in 1972; therefore, no control is being considered.

Lodgepole terminal weevil, *Pissodes terminalis* Hopp., caused extensive damage to lodgepole pine in the Roosevelt and Routt National Forests. In a 40-acre mistletoe study plot, 35 percent of the trees showed current or previous terminal damage. These treees were at least 7 feet tall and about 38 years old. Some trees showed evidence of multiple damage.

Other insects. Defoliation of oak by a looper, *Lambdina* sp., continued on the White River National Forest. Terminal damage was caused by the sugar pine tortrix, *Choristoneura lambertiana* (Busck.), and the southwestern pine tip moth, *Rhyacionia neomexicana* (Dyar), on ponderosa pine, San Juan National Forest. Defoliation of cottonwood along the Arkansas River near Salida, Colo., was caused by the fall webworm, *Hyphantria cunea* (Drury). The western balsam bark beetle, *Dryocoetes confusus* Sw., killed small groups of alpine fir throughout Colorado and Wyoming. The Great Basin tent caterpillar, *Malacosoma fragile* Stretch, continued defoliation of aspen in the Rio Grande National Forest. The elm leaf beetle, *Pyrrhalta luteola* (Muller), defoliated elms in northwest Nebraska along streams and in towns. *Ips pini* (Say) and *I. calligraphus* (Germ.), which had built up in slash from Christmas tree cuttings, caused mortality in ponderosa pine in the Sand Hills area of the Nebraska National Forest. The Zimmerman pine moth, *Dioryctria zimmermani* (Grote), and the western pine tip moth, *R. bushnelli* Busck., continue to cause extensive damage to young ponderosa pine in shelterbelts.

Status of Diseases

The dwarf mistletoes, *Arceuthobium* spp., cause more growth loss in forest trees than any other tree disease in the region. The most prevalent species are lodgepole pine dwarf mistletoe, *A. americanum* Nutt. ex. Engelm., on lodgepole pine; western dwarf mistletoe, *A. campylopodum* Engelm., on ponderosa pine; limber pine dwarf mistletoe, *A. cyanocarpum* Coulter & Nelson, on limber pine; and Douglas-fir dwarf mistletoe, *A. douglasii* Engelm., on Douglas-fir. Dwarf mistletoe control in the form of overstory removal in 10- to 20-year-old timber sale areas in lodgepole pine was practiced on more than 1,500 acres in six National Forests in Colorado and Wyoming. In addition, about 1,300 acres of potential control area in lodgepole pine was surveyed in 1971.

Timber-producing areas are given first priority in a three-stage regional mistletoe control program that involves overstory removal, growth impact evaluation surveys, and sanitation thinning. The program is being organized by management units into multiyear mistletoe control action plans.

Data collected from 12 dwarf mistletoe surveys, including a 100 percent survey of 40 acres of 20- to 40-year-old lodgepole pine in the North Park District of the Routt National Forest, are being analyzed and evaluated. The study will be continued until a survey procedure is selected that will provide the data needed to make control decisions for thinning projects. Dr. Frank Hawksworth and Dr. Jacob L. Kovner from the Rocky Mountain Forest and Range Experiment Station are assisting in the study.

Cooperative study plots were established in 1965 by the region and the station to assess silvicultural control of dwarf mistletoe. Data collected from these plots will be included in a progress report to be issued in early 1972.

Comandra blister rust, *Cronartium comandrae* Pk., is a destructive and prevalent disease of lodgepole pine, particularly in northern and

F–521537

This lodgepole pine overstory is heavily infected with dwarf mistletoe; spread of infection is threatening the future of the new regeneration below (Central Rocky Mountains).

western Wyoming. The presence of the rust along with dwarf mistletoe has created a difficult management situation. The widespread damage to pole and mature stands during heavy infection years in the 1930's and 1940's is now evidenced by tree mortality, dead and dying tops, and growth loss. The disease in many stands has prematurely killed the crop trees.

Two lodgepole pine stands, 15 to 25 years of age, in the Wind River Ranger District of the Shoshone National Forest were surveyed. Between 5 and 6 percent of the 1,200 trees examined were infected with comandra rust. The

infections were found on trees 2 to 10 years old. Additional study is needed to determine how serious the disease is to lodgepole pine management in that area. The rust, although present throughout much of the region, is most serious in the Shoshone National Forest. Occasionally the rust is found on ponderosa pine.

Western gall rust, *Peridermium harknessii* Moore, is present throughout much of the region with heavier than usual numbers of galls observed in some parts of the Bighorn, Roosevelt, and Black Hills National Forests. The rust is not as destructive as comandra rust because a high percentage of the infections occur as branch galls. Whenever possible, trees with stem galls are discriminated against in timber stand improvement work. In one unusual situation, ponderosa pine planted in an old burn in the Black Hills National Forest became heavily infected with the rust. The numerous galls have girdled the branches causing the trees to die. The rust is equally prevalent on ponderosa and lodgepole pine throughout the region.

White pine blister rust, *Cronartium ribicola* Fisch., is known to occur on pine in varying intensities in northwestern Wyoming, in the northern half of the Bighorn Mountains, and about 60 miles north of Laramie in southeastern Wyoming. The rust center discovered in the Laramie Mountains in 1969 is of more recent origin than that in the Bighorn Mountains, indicating the disease is still spreading in the Central Rocky Mountains.

Fir and spruce broom rusts, *Melampsorella caryophyllacearum* Schroet. and *Chrysomyxa arctostaphyli* Diet., are present in the spruce-fir type with the spruce broom rust found quite commonly in southern Colorado and the fir broom rust more commonly seen in northern Wyoming. Studies by the Intermountain and Rocky Mountain Forest and Range Experiment Stations have shown a considerable height growth loss associated with rust brooms. Additional studies have shown a considerable amount of rot associated with dead spruce tops that also have dead rust brooms. More research is needed to determine impact and intensification of broom rusts on individual trees and managed stands.

F–521536

Western gall rust on lodgepole pine is found frequently in Colorado and Wyoming as well as other western States.

Shoestring root rot, *Armillaria mellea* Vahl. ex Fr. Tree killing associated with this root rot has been observed by pathologists for several years in seedling-sapling stands of lodgepole pine in Colorado. In a continuing study, the Rocky Mountain Forest and Range Experiment Station has shown a 1 to 2 percent annual mortality rate of 18- to 19-year-old lodgepole pine. Scattered tree mortality associated with *A. mellea* has been observed more recently in alpine fir and Engelmann spruce. Surveys are needed to determine distribution and impact

of this important disease in the different forest types.

Red ring rot, *Fomes pini* (Brot. ex Fr.) Karst. In studies conducted by Rocky Mountain Forest and Range Experiment Station personnel, cull caused by this rot involves 81 percent, 45 percent, and an estimated 20 to 30 percent of the gross board foot volume in mature and overmature Engelmann spruce, alpine fir, and lodgepole pine, respectively. Impact from heartrots can be minimized through shorter rotations. Decay studies on alpine fir show less than 2 percent volume loss in trees less than 100 years old.

White trunk rot of aspen, *Fomes igniarius* (L. ex Fr.) Kickx. In a recent study, approximately 75 percent of the quaking aspen examined and cut down in three campsites in the Creede Ranger District of the Rio Grande National Forest contained rot caused by *F. igniarius*. A study by the Rocky Mountain Experiment Station showed that *F. igniarius* caused the greatest volume loss of any identified decay fungus. The same study showed increasing amounts of rot occurred in aspen stands more than 100 years old and on poorer sites. Shorter rotations and prevention of wounds and scars are two practical ways that land managers can reduce losses from this disease.

Aspen cankers. In a survey conducted in 1960, Thomas E. Hinds, Rocky Mountain Forest and Range Experiment Station, reported the incidence of five major cankers after examining more than 4,000 quaking aspen in Colorado. The major causal organisms of aspen cankers are *Cytospora chrysosperma* Pers. ex Fr., *Cenangium singulare* (Rehm.) Davids. & Cash, *Ceratocystis* sp., and *Hypoxylon pruinatum* (Klotzsch.) Cke.

Cankers caused by *C. fimbriata* and *C. chrysosperma* had the highest incidence, occurring on about 5 percent of the living trees. Cankers are frequently found on trees invaded by the heartrot fungus, *F. igniarius*. The prevention of wounds, which are common entrance points for canker and decay organisms in aspen, is strongly recommended to land managers, particularly in recreation sites.

F–521541

These sporophores (conks), growing from branch stubs, are the fruiting bodies of *Fomes igniarius*, one of the most common heartrot fungi of hardwoods in the world.

Foliage diseases. Foliage diseases on aspen and the different pine species are cyclic in their incidence and amount of damage observed in Colorado. Every year at least some clones of aspen affected by *Ciborinia whetzelii* Whetz. or *Marssonina populi* (Lib.) Magn. are detected during aerial detection flights. Clonal differences in susceptibility are quite striking.

Some of the more common foliage diseases on conifers in the region are *Davisomycella ponderosae* (Staley) Dark., *Hypoderma saccatum* Dark., *Dothistroma pini* Hulb., *Diplodia pinea* (Desm.) Kickx., and *Elytroderma deformans* (Weir) Dark. Natural stands of ponderosa pine at Scotts Bluff National Monument

F–521540

Aspen being girdled by the sooty-bark canker *Cenenguim singulare*. Note massive canker at dead branch, upper center (Routt National Forest, Colo.).

in Nebraska have been treated until recently with fungicides to control needle cast diseases.

Other diseases. An outbreak of Dutch elm disease, *Ceratocystis ulmi* (Buism.) C. Mor., in central Nebraska at the Bessey Nursery, Nebraska National Forest, was evaluated last fall with formal control practices initiated in early 1971. More than 100 American elms were removed and burned last winter and the remainder pruned and sprayed with the insecticide methoxychlor. Only 30 trees of high esthetic and recreational value are now being protected. These trees, located near buildings and in a recreation area, provide the shade that is a valuable commodity during summer in the Nebraska Sand Hills. A continuing control program will attempt to prolong the life of the remaining elms until suitable replacements are established.

A root and vascular disease, *Verticicladiella wageneri* Kend., has been receiving more attention in the West as a tree killer, particularly of pinyon pine. The disease has been observed causing extensive mortality on pinyon pine in four different locations in Colorado. Junipers growing in close proximity are not showing injury. This disease, which has been reported on ponderosa pine and Douglas-fir in California, will be given additional attention in the surveillance program of the Rocky Mountain Region.

F–521538

This slow-growing, Nectria-like canker on aspen is caused by a species of *Ceratocystis* (San Juan National Forest, Colo.).

F–521539

Light-colored aspen stand in center of this aerial view has been defoliated by the ink spot disease, *Ciborinia whatzelii* (White River National Forest, Colo.).

SOUTHWESTERN STATES (R-3)[4]

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Conditions in Brief

Record low winter temperatures, a spring drought, and gale-force winds significantly affected the insect situation in 1971 in the Southwest. Spruce beetle populations, hard hit by —40° F. temperatures in January, are decreasing throughout the region. The spring drought predisposed ponderosa and pinyon pine to engraver beetle attack throughout New Mexico and Arizona. High winds in October caused extensive blowdown in the ponderosa pine, mixed conifer, and spruce forests, thus creating conditions favorable for population buildup of several important bark beetle pests. The roundheaded pine beetle remained at epidemic levels on the Lincoln National Forest and Mescalero-Apache Indian Reservation, N.Mex. Spruce beetle populations were reduced to low levels. Tree killing by the Douglas-fir beetle increased on the North Rim of Grand Canyon National Park, Ariz.

[4] Includes all forested lands in Arizona and New Mexico and National Park Service land in southern Colorado and western Texas.

Defoliator activity increased in the Southwest. Western spruce budworm populations, which have been endemic for several years, showed signs of again becoming a major pest. The western tent caterpillar heavily defoliated aspen on private and National Forest lands in northern New Mexico and on National Forest lands near Tucson, Ariz.

The most important forest disease problem in 1971 was caused by the dwarf mistletoes. Continuing emphasis was placed on the integration of dwarf mistletoe preventative measures into the management of timber stands and recreation areas. Considerable emphasis was placed on evaluating air pollution injury to forest vegetation. A regionwide detection survey was started to determine the extent and potential of air pollution injury.

Status of Insects

Spruce beetle, *Dendroctonus rufipennis* (Kby.), populations remained active in the high mountain regions of the Southwest. Engelmann spruce stands sustained moderate volume losses from this pest in the White Mountains of the Fort Apache Indian Reservation and adjacent Mount Baldy Primitive Area, Apache National Forest, Ariz. Beetle populations in this area increased progressively from 1967 to 1969 and became epidemic on 40,000 acres of spruce in 1970. Minor outbreaks, causing light tree mortality, continued in Grand Canyon National Park and Apache and Coconino National Forests in Arizona and on the Philmont Scout Ranch and Cibola, Carson, and Santa Fe National Forests in New Mexico.

Record low temperatures were common throughout much of the Southwest in January 1971. Hawley Lake, Ariz., an area near the Fort Apache Indian Reservation beetle infestation, recorded an all-time State low of —40° F. Abnormally low temperatures were prevalent for at least 6 straight days. Prolonged low temperatures in the past have proven detrimental to spruce beetle populations in Colorado, Idaho, and Montana. A biological evaluation was conducted on the Fort Apache Indian Reservation after the cold spell. Analysis of the data showed an average of 90 percent larval reduction. Hibernating adult spruce beetles showed a significantly higher survival rate, with an overall winter loss of 43 percent. Overwintering spruce beetle populations in New Mexico were also reduced by the cold weather.

Wind velocities of more than 70 miles per hour on October 29, 1971, resulted in broken and blown down trees throughout many timbered areas in parts of Arizona and New Mexico. Some small pockets of Engelmann spruce in the higher mountains were completely windthrown. The abundance of preferred food material could result in a resurgence of the declining beetle population.

Evaluation techniques were refined using a variable sample plot and a tailored computer program to expedite time-consuming office analysis of field data. This method offers the land manager considerably more information about the stand composition of infested areas than methods previously used.

Spruce trees treated with cacodylic acid and felled in the fall appear to serve as lethal traps to the spruce beetle. An evaluation made on the Fort Apache Indian Reservation showed that trees treated in September 1970 and felled 4 weeks later were attractive to adults flying in the summer of 1971. Very few progeny survived in treated trees, while survivors were common in nontreated traps.

Douglas-fir beetle, *Dendroctonus pseudotsugae* Hopk. Tree killing by the Douglas-fir beetle increased on the North Rim of Grand Canyon National Park. The park and adjoining Kaibab National Forest were severely attacked by this pest in the 1960's. The majority of the mature and overmature Douglas-fir host was killed during the earlier infestation. The present resurgence of this infestation has little significance, since only a limited amount of susceptible host material remains.

Roundheaded pine beetle, *Dendroctonus adjunctus* Blandf., populations and associated ips bark beetles continued at epidemic levels on the Lincoln National Forest and the adjacent Mescalero-Apache Indian Reservation in

F-521512

If extremely cold weather occurs an evaluation is made to determine winterkill of spruce beetle larvae.

southern New Mexico. Impact survey data showed the infestation on 150,000 acres containing an estimated 400,000 infested pole-sized ponderosa pine. Roundheaded pine beetle populations were not adversely affected by —25° F. temperatures. The infestation has moved north from the Sacramento Mountains and is now centered in the White Mountains around Ruidoso. An ips bark beetle complex, associated with the roundheaded pine beetle became the primary pest in this drought-weakened stand.

A project was initiated in the fall of 1970 and spring of 1971 to suppress roundheaded pine beetle populations in ponderosa pine near Riggs Lake, Coronado National Forest, Ariz. A total of 410 trees were felled, bucked, limbed, turned, and treated with a solution containing 1 pound of ethylene dibromide per 5 gallons of fuel oil. The treatment successfully killed the beetles within the infested trees. An examination will be made in the spring of 1972 to determine if the treatment prevented heavy tree mortality in the remaining stand by the fall 1971 beetle flight.

Tent caterpillars, *Malacosoma* spp. Activity by a tent caterpillar complex increased significantly in the Southwestern Region in 1971. Defoliation occurred on quaking aspen, chokecherry, wild rose, cottonwood, and *Ribes* spp. Heaviest damage occurred near Chama, N. Mex., and Tucson, Ariz. On the Carson National Forest and private lands west of Chama,

6,000 acres of aspen were completely defoliated by the western tent caterpillar, *M. californicum* (Pack.). Tent caterpillar larvae were so thick on the tracks of the steep Rio Chama section of the Cumbres and Toltec Scenic Narrowgage Railroad that the train was forced to a stop several times during the summer. Evaluation data indicate an expansion of the infestation and heavy defoliation in 1972. In the spring of 1971, egg masses of *M. californicum* were found on aspen at Mount Lemmon, Coronado National Forest, near Tucson. The subsequent larval population heavily defoliated aspen stands in the area. Western tent caterpillar larvae defoliated aspen, wild rose, and *Ribes* spp. on the Alpine District, Apache National Forest, Ariz. Evaluation in the early spring of 1972 will determine the trend of this pest.

The southwestern tent caterpillar, *M. incurvum* Hy. Edw., continued to defoliate Fremont cottonwood and Goodding willow in Sabino Canyon Recreation Area, Coronado National Forest, near Tucson. A pilot control study to test Thuricide HPC, a material containing the bacterium *Baccillus thuringiensis* B., was planned for March 1971. However, a temporary use permit could not be obtained before the larvae had reached the late instars of development, necessitating postponement of the test. A spring evaluation showed that moths emerged from only 44 percent of the

F-521513

Blowdowns, such as this one in an Engelmann spruce stand, often trigger spruce beetle outbreaks (Santa Fe National Forest, N. Mex.).

cocoons. Dipterous and hymenopterous parasites emerged from 37 percent of the cocoons. Significantly fewer egg masses were found in May 1971 than in the previous generation. Therefore, less defoliation is anticipated in the spring of 1972. Parasitism, predation, and overcrowding are thought to be the reasons for the population decline. No suppression action is planned at Sabino Canyon in 1972.

Larvae of *M. incurvum* again defoliated cottonwoods around the campground at Glen Canyon National Recreation Area, near Page, Ariz. The National Park Service applied a formulation of carbaryl in water to the infested trees.

Western spruce budworm, *Choristoneura occidentalis* Free., populations that had been at endemic levels in 1970 showed renewed activity in northern New Mexico. Moderate to heavy defoliation was noted on 50,000 acres on the Carson National Forest and Taos-Pueblo Indian lands. Egg mass survey data indicate an upward trend.

Other insects. The red turpentine beetle, *Dendroctonus valens* LeC., has caused scattered mortality in mature ponderosa pine throughout the region. The *dendroctonus* complex of the western pine beetle, *D. brevicomis* LeC., and the Mexican pine beetle, *D. parallelocollis* Chapvis, also showed renewed activity in the

F–521514

Ips bark beetles may be controlled by creating temperature extremes through use of polyethylene sheeting (Lincoln National Forest, N. Mex.).

Southwest. The spring drought is thought to be the primary factor in the increase of these pests that are normally secondary in the Southwest. The alder flea beetle, *Altica ambiens* LeC., that had severely defoliated longleaf cottonwood in 1970 near the Gila Cliff Dwellings in southern New Mexico returned to endemic levels in 1971. The fir engraver, *Scolytus ventralis* LeC., continued to kill small groups of subalpine fir throughout the region. Douglas-fir tussock moth, *Hemerocampa pseudotsugata* McD., caused light to moderate defoliation of white fir and Douglas-fir on Pinal Peak, south of Globe, Ariz. The pinyon needle scale, *Matsucoccus acalyptus* Herb., defoliated pinyon pine throughout the region.

Status of Diseases

Air pollution. In 1971, a regionwide detection survey was conducted for air pollution-caused forest diseases. Thirty-five areas in National Parks, National Monuments, National Forests, and Indian Reservations were surveyed. Some of the areas were located where major atmospheric contamination sources now exist. Others were in areas where major sources will exist in the near future.

Trees in all of the surveyed areas were examined for symptoms of acute sulfur dioxide injury. Symptoms typical of acute injury were observed in only two areas. One of the areas was within 4 miles of the copper smelter at Miami, Ariz. The other was within 4 miles of the copper smelter at Morenci, Ariz. Symptoms resembling chronic sulfur dioxide injury were observed in several additional areas.

Dwarf mistletoes, *Arceuthobium* spp., are the most widespread and destructive disease-causing agents in the forest lands of the Southwest. Of the eight dwarf mistletoes that occur in this area, Southwestern dwarf mistletoe, *Arceuthobium vaginatum* subsp. *cryptopodum* (Engelm.) Hawks. and Wiens, which occurs on ponderosa pine and Apache pine, is the most important. Douglas-fir dwarf mistletoe, *A. douglasii* Engelm., on Douglas-fir, is next in importance. The six other dwarf mistletoes that occur in the Southwest are of local importance. Annual losses caused by *A. vaginatum* subsp. *cryptopodum* may exceed 150 million board feet.

Control is being achieved largely through incorporating preventive measures into cultural stand treatments. Preventive measures presently used include removing infected trees from stands during seed-tree cutting and harvesting poor-risk infected trees during intermediate cutting. The six-class mistletoe rating system is being used to determine risk categories.

Dwarf mistletoe-infected trees have been pruned and selectively cut in some recreation areas. Pruning is expected to enhance tree vigor in these high-value areas. Some selective cutting was done to remove infected overstory trees where stocking of desirable leave trees was adequate.

Winter injury. During the period January 3 to January 8, 1971, temperatures in the Southwest were extremely low. The weather station at Hawley Lake, Ariz., for example, reported a record low of −40° F. Reports of injured trees were later received from several areas in both New Mexico and Arizona. Ponderosa pine and pinyon pine seedlings and saplings in canyon bottoms and other frost-pocket areas were seriously affected. However, little permanent damage seems to have occurred. Recovery of severely injured trees in some localized areas was subsequently hampered by drought conditions.

Armillaria root rot, *Armillaria mellea* (Vahl.) Quel., has been found in four ponderosa pine plantations in central New Mexico and has caused serious mortality in one. The disease has also been found in one ponderosa pine plantation in Arizona. Surveys are being conducted in plantations throughout the Southwest to determine the distribution and damage of this disease.

Texas root rot, *Phymatotrichum omnivorum* (Shear) Dugg., continued to be a problem at Big Bend National Park, Tex. Cottonwood cuttings imported from an eastern nursery and planted on approximately 300 acres of old farmland proved to be extremely susceptible

to this disease. More than 100 trees have died each year for the last 3 years. Less susceptible species are being planted where the root rot is a problem.

Verticicladiella root rot, *Verticicladiella wageneri* Kend., has been associated with damage to pinyon pine at Mesa Verde National Park, Colo. Localized infection centers have remained active, with a relatively large number of trees being killed.

Red rot, *Polyporus anceps* Pk., is the major cause of defect in ponderosa pine in the Southwest. This heartrot disease accounts for losses of 15 to 25 percent of the gross sawtimber volume harvested from virgin stands. In second-growth stands, losses are rarely less than 5 percent in a 150-year rotation but may be reduced to 2½ percent if trees are cut when 120 years old. Disease losses are being reduced primarily through silvicultural and timber management practices.

Miscellaneous diseases. Aspen in the Southwest, as elsewhere, is extremely prone to disease problems. Several canker diseases occur on aspen, including Hypoxylon canker, *Hypoxylon pruinatum* (Klotzsch.) Cke., and sooty-bark canker, *Cenangium singulare* (Rehm.) Davids. & Cash. Both of these diseases have caused mortality in recreation areas. *Fomes applanatus* (Pers. ex S.F. Gray) Gill is an important cause of root and butt rot and has frequently been associated with windthrow.

Limb rust, *Peridermium filamentosum* Pk., has been associated with mortality in ponderosa pine. Spruce broom rust, *Chrysomyxa arctostaphyli* Diet., and fir broom rust, *Melampsorella caryophyllacearum* Schroet., are important in recreation areas where they are associated with bole deformation, spiketop, and mortality. No direct control is being undertaken for diseases of this type. Land managers are encouraged to reduce losses by removing poor-risk trees during normal intermediate cuttings.

Needle cast of ponderosa pine was at an endemic level in 1971. The three needle cast fungi which have been associated with spectacular damage in the past are *Elytroderma deformans* (Weir) Dark., *Davisomycella ponderosae* (Staley) Dubin, and *Lophodermella cerina* (Dark.) Dark.

SOUTHERN AND SOUTHEASTERN STATES (R–8)[5]

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Conditions in Brief

The southern pine beetle continues to generate the greatest concern in the South. Beetle populations increased throughout the region with significant increases in Louisiana, eastern Texas, western North Carolina, eastern Tennessee, and central Georgia. Infestations on the Delmarva Peninsula in Virginia have subsided somewhat in intensity but have become more extensive.

Ips engraver beetle activity was generally less troublesome in the South in 1971 than in 1970. A notable exception was in Florida where ips beetles were primarily responsible for a 50 percent increase in wood volume losses over 1970 losses.

The destructive populations of the Virginia pine sawfly in Virginia, Tennessee, North Carolina, and Kentucky have begun to show signs of decline. A number of other sawfly species were reported locally abundant but caused little significant damage. The sudden appearance of the white pine sawfly in a North Carolina tree seed orchard caused serious mortality.

Hardwood defoliators were very active in the South in 1971. The variable oak leaf caterpillar continued active on 2 million acres of

[5] Includes forested lands in Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, and Virginia.

oak in Arkansas and northwest Louisiana. The forest tent caterpillar again defoliated 47,000 acres of water tupelo in southwest Alabama and about 520,000 acres in southern Louisiana. The walkingstick intensified its defoliation activity in Arkansas, with approximately 135,000 acres being affected.

Southern fusiform rust continues to be the most widespread and serious disease in the South. Cooperative Federal-State surveys were made in most of the Southern and Southeastern States during 1971. A pilot study to evaluate a pathological inoculation method that will be used to determine rust resistance of slash and loblolly pines was begun in Asheville, N.C.

Annosus root rot is still causing severe mortality in localized areas, especially those where pines were planted on old agricultural sites with sandy soil and where no stump treatments were made after thinnings.

There has been a decided downtrend in oak wilt over the past 10 years in both number of infection centers and number of infected trees discovered. This downtrend has been noted in Virginia, North Carolina, Tennessee, Kentucky, and Arkansas.

A needle cast epidemic on slash, loblolly, and longleaf pine occurred along the Gulf Coast from Texas to northern Florida and southern Georgia during the winter and early spring of 1971. More than 54 million acres of forest land were affected. No tree mortality was directly attributed to this infection.

Comandra blister rust, which has been prevalent on the Cumberland Plateau in eastern Tennessee and northern Arkansas, appears to have stabilized in movement for the present.

Several instances of environmental pollution of forest trees were evaluated in 1971. Rupture of a high-pressure anhydrous ammonia line in Arkansas resulted in damage to 9,600 acres of forested land. Needle tip burn of eastern white pine was severe in several localized areas in the Southern Appalachian Mountains during the summer.

Cylindrocladium root rot continued to cause serious damage to black walnut and yellow-poplar seedlings in State nurseries in North Carolina and Alabama. Damping-off of pine and hardwood seedlings continues to cause localized severe damage in nursery beds, especially those which have not been fumigated.

Status of Insects

Southern pine beetle, *Dendroctonus frontalis* Zimm. Fall surveys revealed a tremendous upswing in southern pine beetle activity in the South and Southeast. Heavy beetle losses are now occurring in areas where beetle activity was low for the past 2 to 3 years. In South Carolina the Andrew Pickens District of the Francis Marion and Sumter National Forests is experiencing a level of infestation estimated at 118 trees per thousand acres of host type. This estimate exceeds anything recorded on that district during the past 9 years. On the Enoree Division (Tyger-Enoree Districts) of the same forest, significant populations of the beetle are also present but at a lower level. State and private lands in the north-central portion of South Carolina are also experiencing new southern pine beetle activity. The activity is generally characterized by extremely high populations in localized spots. The potential for damage next spring and summer is high, and suppression measures are currently underway.

In Tennessee southern pine beetle activity continues to be restricted to about 80,000 acres on the Tellico Ranger District of the Cherokee National Forest in the eastern portion of the State. Intensive winter salvage and/or cut and burn efforts currently underway should reduce the damage potential for next spring. The current fall level of infestation is estimated at approximately 180 infested trees per thousand acres of host type.

One of the highest infestation levels ever recorded in the Southeast is occurring over approximately 25,000 acres in the Gatlinburg area of the Great Smoky Mountains National Park. This infestation is estimated at more than a thousand trees per thousand acres of host type and is in a previously noninfested area of the Smokies. The chronic infestations in the Cades Cove and Fontana Lake areas of the park are at a very low level this year.

In North Carolina the Tusquitee Ranger District of the Nantahala National Forest continues to suffer heavy beetle damage. The level

of infestation in the fall of 1971 was estimated at 500 infested trees per thousand acres of host type and represents an eightfold increase over previous spring estimates. Active salvage suppression projects are currently underway to reduce damage and outbreak potential.

F–521551

This downy woodpecker is feeding on larvae of the southern pine beetle (Nantahala National Forest, N.C.).

In other portions of North Carolina southern pine beetle infestations are causing variable levels of damage. On the Uwharrie District of the Uwharrie National Forest in the central portion of the State, heavy damage is occurring in large spots. Infestations are also present on the King's Mountain National Battlefield Park and the adjoining King's Mountain State Park on the North Carolina-South Carolina state line. On State and private lands in North Carolina, beetle activity increased in the Eastern Piedmont and remained about static in other counties of the eastern area.

In Virginia seasonal increases are occurring in the Piedmont and Coastal Plain areas of the State. Most serious is the outbreak which is occurring in Accomac County where over 15 million board feet of timber has already been lost. A fall survey of the Delmarva Peninsula (Virginia, Maryland, and Delaware) indicated that beetle populations are generally down except in Accomac County, Va., and that in Worcester County, Md., moderate to high potential for future damage still exists. While the average size of active spots has decreased, the number of active spots has increased slightly in these two counties.

Southern pine beetle populations have again become a significant cause for concern to forest land managers in central Louisiana and eastern Texas. Many large infestations have been observed on private and National Forest lands in Louisiana and on private land in the southern portion of the eastern Texas outbreak area. Population levels remain moderate to low on the National Forest lands in Texas.

Populations of *D. frontalis* increased to a 3-year high on the Homochitto National Forest in Mississippi, and increases have also been reported on private land in Franklin, Amite, and Wilkinson Counties in the southwestern part of the State.

New areas of southern pine beetle infestation have been detected in 15 counties in north-central Georgia. Potential is high for continued activity and increased damage next spring. Extremely high southern pine beetle populations have been detected recently on the Hitchiti Experimental Forest, the Uncle Remus District of the Oconee National Forest, and the Piedmont National Wildlife Refuge in central Georgia. Individual spot infestations exceeding 800 trees have been reported. Salvage and/or cutting and burning of infested material continue to be the primary suppressive measures for the southern pine beetle in the Southeast. Chemical control measures are utilized only in special cases where the above-mentioned methods are determined to be unfeasible or impractical.

Balsam woolly aphid, *Adelges piceae* (Ratz.). The balsam woolly aphid continues to exert an

F–521552

A specialized operator horse-logging killed and recently infested pines attacked by the southern pine beetle (Nantahala National Forest, N.C.).

impact on 60,000 acres of host fir type in the Southern Appalachians. There are no new infestation areas but most of the older infestations continued to spread to adjacent stands. The only major area of fir type where infestations have not yet been found is on the Mount Rogers National Recreational Area in Virginia. Chemical control, as in the past, will be conducted only in high-value Fraser fir stands. Control projects are planned for Roan Mountain on the Pisgah National Forest and for Mount Mitchell State Park in North Carolina.

Black turpentine beetle, *Dendroctonus terebrans* (Oliv.). Populations of this beetle in the Southeast in 1971 continued to cause sporadic damage ranging from negligible to heavy wherever weakened pine stands occurred. In North Carolina chemical suppression was necessary on a 68-acre recreation area in the Pisgah National Forest. In South Carolina the severe outbreak which existed in 1971 in the north-central Sandhills Region declined largely due to an effective salvage program. Increases in mortality caused by black turpentine beetle occurred in Florida where drought, gum farming, and cutting, predisposed trees to attack.

Black turpentine beetle activity on the Catahoula and Winn Districts of the Kisatchie National Forest in Louisiana was associated with heavy bole damage caused by logging operations. Bole damage caused by military maneuvers was associated with the activity in the Camp Shelby area of the Black Creek Ranger District in Mississippi. Construction operations were also responsible for the turpentine beetle activity in eastern Texas and Arkansas.

Ips engraver beetles, *Ips* spp. The Mississippi Forestry Commission reported a marked reduction in ips engraver beetle activity in the areas affected by Hurricane Camille. Engraver beetle damage has been reported in 16 counties

in southeast Texas where spots containing as many as 200 infested trees occurred. Arkansas reported infestations of *Ips* spp. beetles in the Sheridan, Oden, Camden, Wickes, Pine Bluff, Fordyce, and Arkadelphia areas.

Populations of ips engraver beetles were generally static over the Southeast during 1971 with the exception of Florida where they were cited as the primary cause for a 50 percent increase over 1970 in total wood volume loss. The losses occurred primarily in plantations on drier sites and on wildfire sites in southern Florida.

Pine sawflies, *Neodiprion* spp. The widespread occurrence of the Virginia pine sawfly, *N. pratti pratti* (Dyar), over Virginia, Tennessee, North Carolina, and Kentucky has shown signs of decline after several years of relative abundance. These States reported negligible to light activity and occasional heavy localized infestations.

Other sawflies causing sporadic damage in the Southeast in 1971 include Arkansas sawfly, *N. taedae linearis* Ross, most active in Tennessee, Louisiana, and Mississippi; redheaded pine sawfly, *N. lecontei* (Fitch), scattered occurrence; and Hetrick's sawfly, *N. hetricki* (Ross); *N. virginianus* Rohw.; *and N. excitans,* Roh. An unidentified species of *Neodiprion* severely defoliated shortleaf pine in and around Robber's Cave State Park near Wilburton, Okla. A sudden increase in the white pine sawfly population, *N. pinetum* (Norton), on the Beech Creek Seed Orchard, Murphy, N.C., caused complete defoliation of several trees.

Seed orchard insects. Most insect problems on Federal seed orchards in the Southeast are related to insects affecting the growth and/or survival of the trees rather than to insects affecting seed and cones. The majority of seed orchards are young and have not yet reached full production. The major insect problem in 1971 involved the Nantucket pine tip moth, *Rhyacionia frustrana* (Comst.). Suppression measures to prevent serious damage were necessary in two Federal seed orchards in North and South Carolina this year.

A cone moth, *Eucosma* sp., caused an average loss of 4.5 percent of the white pine cones at the Edwards Seed Orchard at Morganton, N.C. Another species of *Eucosma* was responsible for destroying up to 50 percent of the cones on some clones of Virginia pine at the same seed orchard. Light to heavy defoliation of loblolly pine at the Erambert Seed Orchard in Mississippi was attributed to a *Contarinia* midge. In several counties in Texas approximately 3,400 seedlings were damaged by the Texas leaf-cutting ant, *Atta texana* (Buckl.).

Forest tent caterpillar, *Malacosoma disstria* Hbn., activity in the South increased slightly during 1971. Approximately 47,000 acres of water tupelo in the Mobile and Tensaw River Basins were defoliated. Some 520,000 acres of tupelo were defoliated in southern Louisiana.

Walkingstick, *Diapheromera femorata* (Say). Outbreak populations of walkingsticks were present on the Ouachita National Forest for the third consecutive year. The 1971 infestation was more extensive and intensive than in 1970 with approximately 135,000 acres of upland oak forest sustaining at least light defoliation.

Variable oak leaf caterpillar, *Heterocampa manteo* (Dbldy.). For the second straight year approximately 2 million acres of oak in Arkansas sustained defoliation. This insect was also one of the defoliators responsible for the light defoliation of 1½ million acres of oak in northwest Louisiana.

Gypsy moth, *Porthetria dispar* (L.), continues its movement into the Southeast. In Virginia, 38 positive male trappings were verified in 14 counties. Accomac County on the eastern shore leads all others with 15 positive trappings. Gypsy moths have also been trapped or found in five scattered locations in North Carolina. A single moth was trapped at Myrtle Beach, S.C. Many of the catches were made in the vicinity of camping and recreation areas indicating dispersion by accidental transport. In May 1971, 160 acres around an infested mobile home park at Pensacola, Fla., were aerially sprayed by the USDA Agriculture Re-

F–521543

Defoliation of northern red oak in Arkansas caused by the walkingstick *Diapheromera femorata.*

search Service. Gypsy moth larvae were found feeding on oak trees near a house trailer. The larvae had been transported from New England in the egg stage on the trailer.

Status of Diseases

Southern fusiform rust, caused by *Cronartium fusiforme* (A&K) Hedge. & Hunt, is probably the most widespread and serious disease in the South. Cooperative Federal-State fusiform rust surveys were conducted in Florida, Louisiana, South Carolina, Arkansas, Georgia, and Mississippi in 1971. Maps of relative rust intensity in slash and loblolly pine plantations 8 to 12 years old are being prepared for each State. This information is very important to industrial, university, Federal, and State tree improvement foresters for development of management plans to know where to plant their improved fusiform rust resistant pines. The last Southwide fusiform rust survey was conducted in 1939.

In addition, the Forest Service Forest Pest Management Group at Asheville, N.C., began an evaluation of a pathological inoculation method to be used to determine rust resistance in selected slash and loblolly pines. This inoculation procedure was developed by the USDA Forest Service's Southeastern Forest Experiment Station and offers promise for implementation on an operational scale. Results should be available by the end of 1972 or soon thereafter.

Fusiform rust is still considered one of the most important nursery disease problems on 1-0 loblolly and slash pine seedlings in the South. Rust cankers on 6- to 10-month-old loblolly and slash pine seedlings are often difficult to detect. Approximately 20 percent of these stem-cankered trees may be shipped to the field despite conscientiously applied cull practices.

Annosus root rot, caused by *Fomes annosus* (Fr.) Karst, is not as serious as once was thought in the Southeast, but it continues to cause extensive damage in thinned pine plantations, especially those planted on old agricultural sites with sandy soil. Eastern white, loblolly, and slash pines are the species most commonly affected. A reduction in the number of plantation thinnings and the use of borax on freshly cut stumps are keeping this disease at tolerable levels. Severe mortality is occurring in pine plantations throughout the area where no stump treatments were made after thinnings. A 6-year (1964–1970) permanent plot study showed that annosus root rot mortality averaged four trees per acre per year in seven thinned untreated white pine plantations in western North Carolina. During the same period, mortality in thinned white pine natural stands was three trees per acre per year. The disease has been found also in seed orchards in Tennessee and North Carolina. *F. annosus* caused considerable damage in a loblolly pine seed orchard in eastern Tennessee. The 12-year-old trees in the orchard were recently moved from the original planting site to a new one. A survey on some 1,500 trees revealed that 23 were infected and several trees were already dead or dying.

F–521548

Fusiform rust canker on a 1–0 loblolly pine. Nursery seedlings of loblolly and slash pine must be treated to prevent high losses from this rust disease.

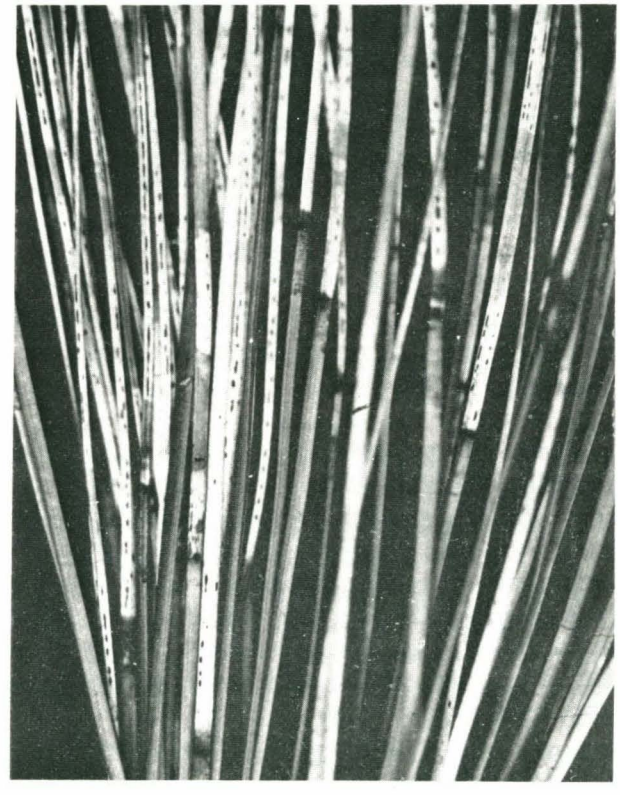
The Virginia Division of Forestry reported that a reexamination of a regenerated area previously heavily infested with *F. annosus* had 3.6 percent of the stems lost to the pathogen after six growing seasons.

Plots were established during 1969 in 11 thinned plantations from Virginia to Texas to evaluate stump treatments for control of *F. annosus.* Treatments included application of sodium nitrite, the fungus *Peniophora,* and borax. Annual data will be taken on the residual trees in the plots for the next 4 years.

Oak wilt, caused by *Ceratocystis fagacearum* (Bretz) Hunt. Oak wilt aerial detection surveys were conducted in Virginia, North Carolina, and South Carolina in 1971. There has been a downtrend of the disease over the past 10 years in both number of infection centers and number of infected trees discovered. During 1970 only 12 centers with 12 infected trees were found in North Carolina. For the first time in 15 years infected trees were not treated. In a nine county survey of 2 million acres in South Carolina, only one new center was discovered: the first one for Richland County. The annual oak wilt survey by the Virginia Division of Forestry found 84 positive infections in 1971. Aerial observation of 56 old centers on the George Washington National Forest revealed that only 16 centers contained currently wilting trees. Only four new centers were observed. Similar trends have been noted in Tennessee, Kentucky, and Arkansas. Ground surveillance is continuing in all the States in which oak wilt has been discovered. Aerial reconnaissance surveys will be made periodically to determine trends.

Dutch elm disease, caused by *Ceratocystis ulmi* (Buism.) C. Moreau, was initially discovered in several Southern States during the past few years. It was detected in Alabama and Mississippi in 1968 and South Carolina and Texas in 1970. Clemson University pathologists made three additional confirmations of the disease in South Carolina in 1971. Winged and American elm were the infected species in all the spots. The disease caused widespread mortality in Tennessee, especially in western Tennessee where elms are numerous in fence rows and woodlots.

A pine needle cast, *Lophodermella cerina* Darker and *Hypoderma lethale* Dearn., was widespread throughout much of the South during the winter and early spring of 1971. The highest incidence occurred along the Gulf Coast from eastern Texas to northern Florida and southern Georgia. Additional areas of heavy infection were found in central Mississippi along the Natchez Trace Parkway. Trees affected by the disease were observed as far north as Tennessee. More than 54 million acres of forest land were affected by the needle cast. Slash pine was the most severely affected. Loblolly pine was heavily affected in some localities but much less so than slash pine. Longleaf pine was affected to a lesser extent. *L. cerina* Darker and *H. lethale* Dearn. were believed to be the primary fungi involved in the disorder. *L. australe* Dearn. was also found on many of the diseased needles but is believed to be a saprophyte. By midsummer the diseased needles were cast and most of the new foliage on previously infected trees appeared normal. No tree mortality could be directly attributed to the infection. Evaluation plots have been established to follow the progress of the disease on a year-to-year basis. Observations made on these plots in December 1971 indicated that very little infection had occurred during the year.



F-521549

The needle cast fungus *Hypoderma lethale* on slash pine; the dark structures on light portions of the needles are the fruiting bodies of the fungus.

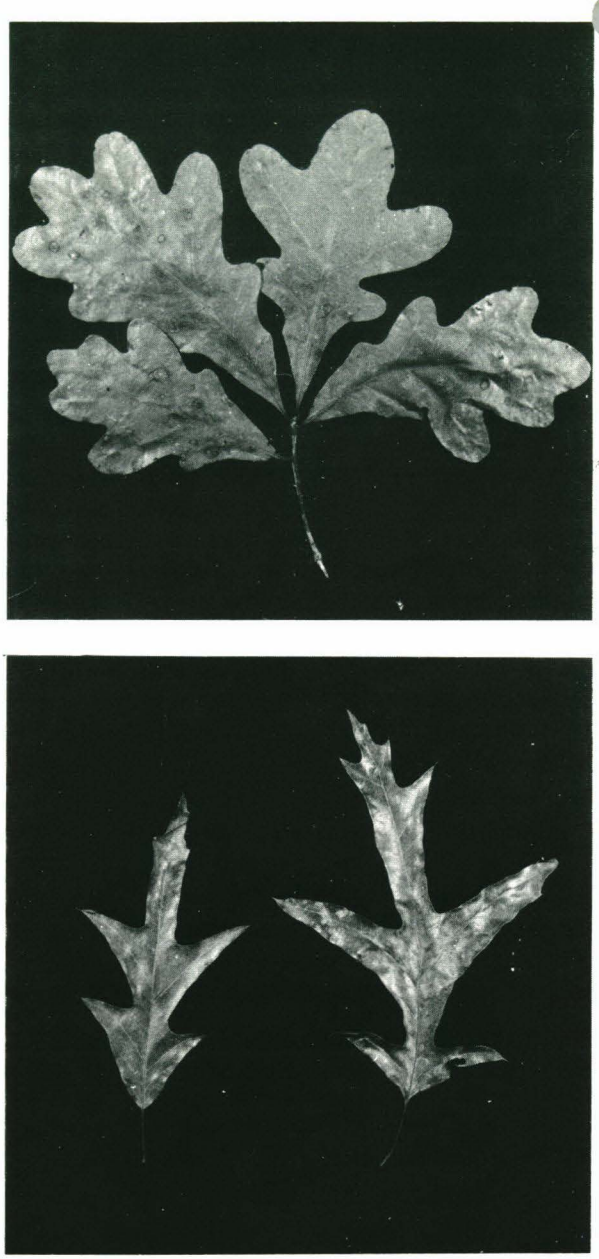
Comandra blister rust, caused by *Cronartium comandrae* Pk., was until recently considered a problem only in the Western and North Central States. However, in 1951 it was detected on loblolly pine saplings located on the Cumberland Plateau in eastern Tennessee. The first comandra blister rust damage in northern Arkansas occurred in 1962 where it caused shortleaf pine mortality in the Ozark National Forest. The disease was detected for the first time east of the Cumberland Plateau in Tennessee during 1971 in a 16-year-old loblolly plantation.

Results from a cooperative Federal-State permanent plot evaluation established in 1968 in Tennessee loblolly plantations 1 to 15 years old indicate that the rate of new comandra rust infection and mortality occurring each year has declined since the initiation of the study. In 1971 the average mortality resulting from rust infection was 7.2 percent. The majority of the mortality occurred in 1- to 5-year-old trees. Final data collections and analyses will be made during the spring of 1972.

Anhydrous ammonia damage. Rupture of a high-pressure anhydrous ammonia transmission line in Independence County, Ark., during June resulted in damage to 9,600 acres of forested land. Heavy mortality of pine, cedar, and hardwoods occurred over 11 acres adjacent to the rupture. Trees showing moderate to light damage over the remaining acreage are expected to recover.

Needle tipburn of eastern white pine. This disorder, which has appeared periodically in the Southern Appalachian Mountains for several years, was severe in several localized areas during summer 1971. Ozone and sulfur dioxide have been implicated with this disorder. Some of the affected trees suffered tipburn over their entire crowns, giving them a dying or dead appearance.

Cylindrocladium root rot, caused by *Cylindrocladium scoparium* Morgan and *C. floridanum* Sobers and Seymour., continues to cause serious damage to black walnut and yellow-poplar seedlings. Approximately 70 percent of 75,000 first-year black walnut seedlings were again severely damaged by *C. scoparium* at the Griffith State Nursery in Clayton, N.C., in 1971. Similar damage was observed in the first-year black walnut seedling beds at this nursery in 1970. In 1968 a closely associated



F-521546, 521547

Damage to white oak *(top)* and red oak foliage from anhydrous ammonia fumes (Arkansas).

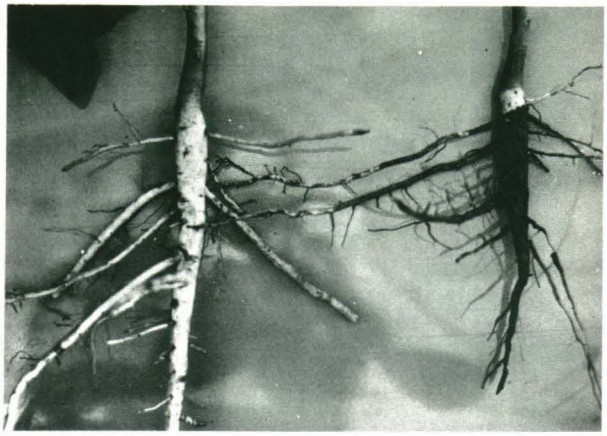
cylindrocladium root rot organism, *C. floridanum*, was associated with severe damage to 1-0 yellow-poplar seedlings at the Edwards State Nursery in Morganton, N.C. Approximately 70 percent of 250,000 yellow-poplar were killed. During the fall of 1971, *C. scoparium* was isolated from diseased black walnut seedlings in the Morgan County State Nursery in northeastern Kentucky.

F–521544

The black walnut nursery seedling with withered and darkened leaves has been killed by cylindrocladium root rot (Alabama nursery).

Disease symptoms of *C. scoparium* on black walnut and *C. floridanum* on yellow-poplar are very similar. The standard soil sterilization treatment of methyl bromide was used prior to seeding in both of the above cases. A stronger penetrating formulation of methyl bromide has been much more effective in reducing the fungus inoculum in the soil.

Black root rot, caused by *Sclerotium batatticola* Taub. (Davis) and *Fusarium oxysporum* Schlect., has caused widespread and localized severe damage to 1-0 loblolly and slash pine seedlings in Southern nurseries. The disease becomes more severe during hot Southern summers when soil temperatures remain at or above 90° F. for long periods. Infected pine roots are blackened and the root cortex sloughs off easily. The primary loss results from damaged root systems which severely weaken the seedlings. Seed bed mortality is uncommon but survival is greatly reduced in outplanted seedlings with damaged root systems.



F–521545

Healthy and cylindrocladium root rot-killed root systems of black walnut seedlings (Alabama nursery).

Root rot, caused by *Sclerotium rolfsii* Sacc., was severe in many nurseries in Alabama and Georgia on *Lespedeza bicolor* which is grown for wildlife food and cover. The fungus was causing a root and crown rot of the seedlings.

The standard dosage rate of methyl bromide has provided good control for all the nursery root rot diseases. Problems occur only in localized portions of nurseries where, for some reason, effective soil fumigation results have not been obtained.

Lophodermium needle cast, *Lophodermium pinastri* (Schrad.) Chev., has caused widespread damage to Scotch pine nursery seedlings and Christmas tree plantings in several localized areas of the Southeast during recent years. Severe needle cast infection (more than 60 percent) was observed in the 2–0 Scotch pine at the Edwards State Nursery in Morganton, N.C., in 1971. Results of a study made at this nursery show the Spanish Scotch pine variety to be highly susceptible to needle cast. Three other Scotch pine varieties—French, Turkish, and Bulgarian—are highly resistant to the disease.

Recent evaluations at a forest tree nursery in North Carolina show the fungicide Maneb to be highly effective in preventing Lophodermium infection on Spanish Scotch pine. Similar con-

F-521550

Close inspection of this Scotch pine will reveal light-colored areas, mostly the tip portions of individual needles, caused by *Lophodermium* needle cast.

trol results have been obtained in the Lake States.

Juniper needle blight, caused by *Phomopsis juniperovora* Hahn, is the most serious disease of eastern redcedar and Arizona cypress in Southern nurseries. Cedar blight damage was observed last summer in several Southeastern States, including North Carolina, South Carolina, and Tennessee. This disease killed approximately 20 percent of the Arizona cypress seedlings at the Auburn University Forestry Department's nursery in Alabama.

Damping-off continues to cause localized severe damage in Southern nurseries. Several different soil fungi, *Fusarium* sp., *Pythium* sp., *Phytophthora* sp., *Rhizoctonia* sp., and, more recently, *Cylindrocladium* sp., have been associated with this disease. Damping-off occurs both prior to and after the seedling emerges above the soil. Damping-off is most severe where the soil pH is above 5.5 and cool, moist soil conditions prevail. Standard soil fumigation with methyl bromide has given satisfactory control of damping-off. In addition, the fungicide captan applied as a soil drench in large volumes of water has been effective in controlling localized severe cases of top post-emergence damping-off.

Miscellaneous diseases. *Atropellis tingens* (Lowman and Cash) was found fruiting on cankered branches of shortleaf pine in Arkansas. Up to 75 percent of the trees in some stands were affected. Damage was usually confined to the smaller branches and resulted in twig dieback. The disease was restricted to poor sites and was found mostly on ridge tops. Heavy mortality of mimosa trees caused by *Polyporus lucidus* Leys ex. Fries root rot was widespread in Mississippi and Louisiana this summer. *A Fusarium* sp. was isolated from the roots of dead and declining 2-year-old loblolly pine seedlings in a plantation in Mississippi. An evaluation of pitch canker, *F. laterium f. pini* (Hepting and Roth), in 15-year-old slash pine plantations in northern Florida revealed 33.6 percent terminal branch infections and 5.3 percent of the crop trees lost due to infection. There was very little increase in infection over the past 2 years.

NORTHEASTERN STATES (R–9)[6]

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Conditions in Brief

Hardwood defoliators were the major forest insect pests in the Northeastern States in 1971,

[6] Report compiled from information submitted by Federal, State, and private cooperators in Illinois, Indiana, Iowa, Maine, Maryland, Massachusetts, Michigan, Minnesota, Missouri, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, West Virginia, and Wisconsin.

[7] Entomologist and pathologist, Delaware, Ohio.

defoliating more than 8 million acres of forested land. The gypsy moth gained its share of attention by defoliating 1.4 million acres; States receiving the most damage were Connecticut, New York, New Jersey, and Pennsylvania. In 1971 State organizations treated 372,000 acres to reduce gypsy moth populations. Infestations of the variable oak leaf caterpillar continued for the second year, defoliating 2 million acres in southeast Missouri. Populations of a red-humped oakworm maintained high levels this year and defoliated 1.3 million acres in four States. Michigan and Minnesota were the most severely affected. The saddled prominent infestation which has plagued seven eastern states for the past several years appears to be declining. Approximately 500,000 acres were defoliated by the saddled prominent in 1971; New Hampshire and Maine accounted for most of this defoliation. Leaf rollers continue to decimate oak stands in Pennsylvania where a million acres were defoliated. *Archips semiferanus* (Wlk.) was the dominant leaf roller in the complex this year. The large aspen tortrix infestation in Minnesota increased to 2 million acres of heavy defoliation in 1971. Infestations are also reported from Michigan and Wisconsin. A recurring insect problem, the forest tent caterpillar caused more than 400,000 acres of defoliation in Minnesota and Pennsylvania.

The spruce budworm continued to have the limelight among the conifer pests in 1971. Minnesota and Maine sustained most of the 4.5 million acres of defoliation. Maine treated 10,000 acres with Zectran in 1971. Pennsylvania reported substantial defoliation of hemlock by the budworm. The southern pine beetle continued to cause pine mortality on the eastern shore of Maryland. Other notable pests causing damage in 1971 were the jack pine budworm, jack pine sawfly, pine looper, and the balsam woolly aphid.

Many of the tree diseases that have caused alarm in the past have become stabilized or have had reduced impact in 1971. Needle cast fungi caused increased damage in 1971 in forest nurseries and Christmas tree plantations. Losses in Scotch pine due to a needle cast were particularly severe.

Reports of forest damage caused by air pollution were more numerous in the Northeastern States during 1971. Sulfur dioxide was responsible for damage in parts of Maryland, West Virginia, and Missouri.

Status of Insects

Gypsy moth, *Porthetria dispar* (L.), continued its upward trend, and defoliation occurred on approximately 1.4 million acres of forested land in 1971 as shown by the following breakdown:

States	*Acres defoliated* [8]		*Acres treated*
	1970	*1971*	*1971*
Connecticut	386,700	655,100	47,000
New York	416,300	479,150	241,000
New Jersey	129,800	180,600	55,000
Pennsylvania	10,500	89,000 [9]	23,000
Massachusetts	6,800	18,800	–
Rhode Island	1,100	8,500	5,900
Vermont	–	4,500 [10]	–
New Hampshire	38,500	3,300	–
Maine	1,080	820	–
Total acreage	990,780	1,439,770	371,900

The gypsy moth has caused extensive damage to forests in the Northeastern Region since its introduction into Massachusetts in 1869. Natural control factors which hold many native insects in balance have often lagged far behind the massive outbreaks of the gypsy moth. The defoliated acreage was 1.5 times that reported in 1970.

In 1971 in the Northeastern States 372,000 acres were treated in high-use areas where tree values were imminently threatened by the gypsy moth. The insecticide carbaryl was used in all States with the exception of a 200-acre pilot test with Dylox in Pennsylvania.

Disparlure is the synthesized female sex attractant of the gypsy moth. One use of the attractant is as a detection tool. Traps baited with disparlure are used in previously uninfested areas to attract males and thereby discover any incipient population buildups. This

[8] Data from Plant Protection Division, Animal and Plant Health Inspection Service, Moorestown, N.J., October 19, 1971.

[9] Another 500,000 acres had 5 to 60 percent defoliation.

[10] Data obtained from State records.

year male moths were trapped in Fulton and Ashland Counties in Ohio and in Monroe County, Wis. This is the first record of the gypsy moth in Wisconsin. Traps placed in Michigan, where a previous infestation was considered eradicated, and in West Virginia, adjacent to outbreaks in neighboring Pennsylvania, failed to recover any male moths. The populations of the gypsy moth are expected to continue on their upward trends in 1972.

Spruce budworm, *Choristoneura fumiferana* (Clem.). The extensive outbreak in northern Minnesota continued for the fifth year with more than 2 million acres defoliated. In Wisconsin an area of 8,000 acres of white spruce, black spruce, and balsam fir were lightly defoliated. Local infestations have declined in lower Michigan but increased in upper Michigan where severe defoliation is expected to occur in 1972. In 1971 Maine treated 10,000 acres with Zectran and reported a mean larval mortality of 96 percent. Maine currently has 2.5 million acres of spruce-fir type infested with the budworm. Populations are expected to continue at high levels in 1972, therefore, Maine anticipates treating 500,000 acres of heavily infested spruce-fir type with Zectran.

Pennsylvania reported 52,000 acres of hemlock defoliated by the budworm, up from 200 acres defoliated in 1970. Tree mortality will probably occur in many of the heavily defoliated areas.

Southern pine beetle, *Dendroctonus frontalis* Zimm. The southern pine beetle continues to cause considerable loblolly pine mortality on the Delmarva Peninsula of Delaware and Maryland. Worcester County, Md., had the highest incidence of beetle activity, with 16 spots or groups of infested trees per thousand acres host type. The total number of red-topped and fading trees was 80 per thousand acres. The typical stand being attacked by the beetle is approximately 35 years old, has reduced increment, has dense stocking, is found on poorly drained soils, and has experienced precipitation abnormalities.

Variable oak leaf caterpillar, *Heterocampa manteo* (Dbldy.). The massive populations of this pest in southeastern Missouri continued, defoliating 2 million acres in 1971. The size of the infestations increased and defoliation was heavy in the areas where it was found in 1970. Defoliation was particularly severe on oak and basswood in 1971. A small infestation of this insect was also detected in Maryland.

Red-humped oakworm, *Symmerista canicosta* Franc. Infestations of this pest were reported from four States where it defoliated 1.3 million acres in 1971. Minnesota reported 725,000 acres of defoliation; Michigan reported 604,000 acres; Wisconsin, 1,000 acres; and Iowa, 100 acres. Populations are expected to continue at high levels in 1972.

F–521521, 521522

Larva of the variable oak leaf caterpillar, a common defoliator of hardwood forests: *top,* larva feeding on oak foliage; *bottom,* overwintering larva in the forest litter.

Saddled prominent, *Heterocampa guttivitta* (Wlk.). Local populations of the saddled prominent declined drastically in Massachusetts, New York, Pennsylvania, and Vermont but increased in New Hampshire and Maine in 1971 as shown in the following tabulation:

States	*Acres defoliated*	
	1970	*1971*
New Hampshire	480,000	493,000
Maine	12,000	26,000
New York	89,000	26,000
Massachusetts	125,000	23,000
Pennsylvania	50,000	2,000
Vermont	136,000	–
Total acreage	892,000	570,000

The overall acreage defoliated remained high, however, totaling more than a half million acres. Pennsylvania reports 10 percent host tree mortality over 5,000 acres with tree dieback occurring over another 2,000 acres as a result of the previous year's saddled prominent defoliation. Mortality of yellow birch is showing up in New England areas which supported 2 or more years of defoliation.

Large aspen tortrix, *Choristoneura conflictana* (Wlk.). The infestation in Minnesota increased to 2 million acres of heavily defoliated aspen. An additional 2 million acres were lightly defoliated. Scattered infestations of this insect have been reported also from upper Michigan, northern Wisconsin, and Isle Royale National Park in Lake Superior.

An oak leaf roller, *Archips semiferanus* (Wlk.). The massive outbreak of this oak leaf roller continued to play havoc with oak stands in Pennsylvania where it defoliated more than a million acres. Last year an estimated 5.5 million trees were killed by this insect. In some counties oak mortality was 90 percent where there were 3 successive years of defoliation. Pennsylvania State University has isolated the Archips sex attractant material; this may well lead to an improved survey or control method in future years. An oak leaf roller control project was conducted at Black Moshannon State Park on 2,200 acres using carbaryl.

Jack pine budworm, *Choristoneura pinus* Free. In northwestern Wisconsin, 30,000 acres were defoliated to various degrees by this pest. Scattered infestations in east-central Minnesota were moderately defoliated. Budworm populations are following an upward trend in lower Michigan.

Forest tent caterpillar, *Malacosoma disstria* Hbn. A widely distributed and recurring insect problem, the forest tent caterpillar once again caused considerable defoliation in the Northeastern Area. Minnesota reported 225,000 acres and Pennsylvania reported 205,000 acres of defoliation by this pest. Ohio and West Virginia reported lighter defoliation, a decline from the heavy defoliation the forests exhibited in 1970. In Missouri this was the first record of the insect causing obvious defoliation in more than 75 years. Pennsylvania treated 1,700 acres of Prince Gallitzin State Park with carbaryl.

Jack pine sawfly, *Neodiprion pratti banksianae* Roh. About 30,000 acres of mature jack pine in upper Michigan was severely damaged by the sawfly this season. An additional 60,000 acres of mixed pine stands showed moderate defoliation. The sawfly was also in lower Michigan where it fed primarily on smaller sized jack pine.

Balsam woolly aphid, *Adelges piceae* (Ratz.). This aphid, usually a problem in Maine, has been reported causing tree mortality in Vermont. Scattered mortality exists over 14,000 acres in Vermont.

Saratoga spittlebug, *Aphrophora saratogensis* (Fitch). Scattered severe infestations occurred in upper and lower Michigan, but increases in some populations did not develop because of lack of moisture or high temperature. Several small infestations were reported also in Maine and New Hampshire. About 300 acres were treated in Wisconsin with Malathion ULV in 1971.

Arborvitae leaf miner, *Argyresthia thuiella* (Pack.). This leaf miner is causing mortality

of northern white cedar in central and northern Vermont. High populations also exist in Maine.

Elm spanworm, *Ennomos subsignarius* (Hbn.). Scattered infestations were reported from New York and Connecticut in 1971. Some areas were defoliated by both the gypsy moth and the elm spanworm. Outbreaks of the spanworm in Massachusetts and Wisconsin have collapsed.

Satin moth, *Stilpnotia salicis* (L.). An outbreak of this tussock moth continued in Maine during 1971 where it defoliated more than 9,000 acres of aspen. The population is much reduced from 1970. A further reduction in damage is anticipated for 1972.

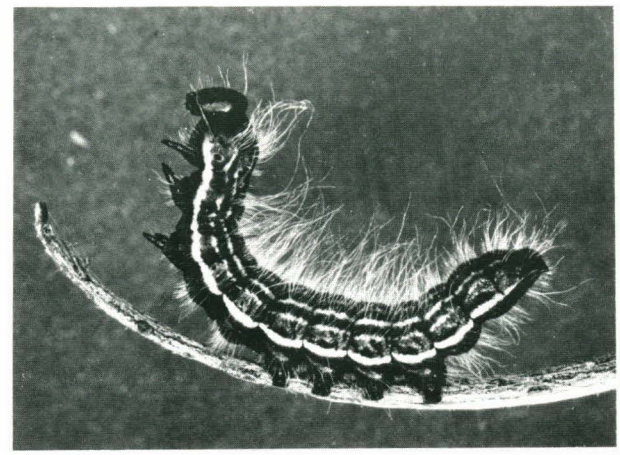
Cherry scallop shell moth, *Hydria prunivorata* (Ferguson). This relatively obscure insect made an unusual upsurge in 1971 and was reported from Maryland, Massachusetts, Michigan, New York, Ohio, Pennsylvania, and West Virginia. New York reported 167,000 acres defoliated, while Pennsylvania noted 10,000 acres heavily or completely defoliated. This insect attacks black cherry and feeds by webbing leaves together and enveloping them within a nest.

Hemlock looper, *Lambdina fiscellaria* (Guenee). A local outbreak of this looper was reported on 1,000 acres in southeastern Massachusetts. A small portion of the infestation was treated with Malathion ULV.

Pine looper, *Lambdina athasaria pellucidaria* (G.&R.). The pine looper was found in August in Delaware where it defoliated 1,000 acres of Virginia pine. The majority of the stands were moderately to heavily defoliated. On Cape Cod 11,000 acres were defoliated by this looper. A small infestation was also reported in Connecticut.

Maple trumpet skeletonizer, *Epinotia acerella* (Clemens), infestations were reported from Maine, New York, Pennsylvania, and Vermont. This skeletonizer is not expected to pose a serious threat to maple stands because it is a late season defoliator.

Walnut caterpillar, *Datana integerrima* (G.&R.). Localized infestations were observed in southeastern Missouri where the caterpillar caused localized heavy defoliation of plantation and native walnut trees. Other infestations were reported in Maryland and Ohio.



F-521524

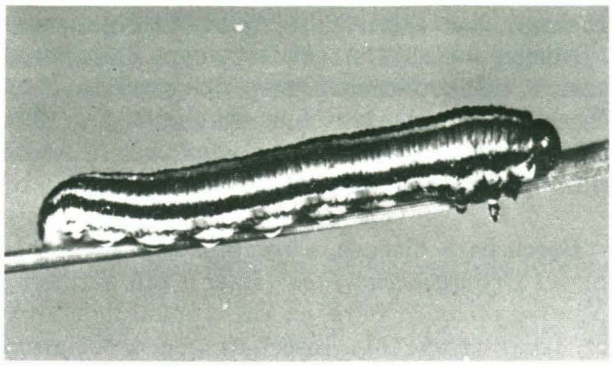
The walnut caterpillar is a recurring pest problem on plantations and natural-occurring black walnut in Ohio and Missouri.

Pine leaf chermid, *Pineus pinifoliae* (Fitch). Galls caused by this insect were abundant on red spruce throughout southern and central Maine. Flagging on the chermid's alternate host, white pine, will be evident in 1972 especially where spruce and pine intermingle.

European pine sawfly, *Neodiprion sertifer* (Geoff.). This sawfly was widespread in Ohio and Illinois in 1971. Red, Scotch, and white pine in northern Ohio had defoliation that often was severe. Illinois generally had lighter populations with Christmas tree plantations receiving the most defoliation. Michigan also reported high populations in Christmas tree plantations in 1971.

Loblolly pine sawfly, *Neodiprion taedae linearis* Ross. Moderate to heavy defoliation occurred on shortleaf pine in southeastern

Missouri. An increase in the loblolly pine sawfly populations was noted in Illinois with both young and older stands receiving defoliation.



F-521523

Larvae of the loblolly pine sawfly are damaging pests of Christmas tree plantations in Illinois and Missouri.

Bagworm, *Thyridopteryx ephemeraeformis* (Haw.). Damage to ornamental and plantation conifers was reported in Ohio, Illinois, and Missouri again in 1971. In some areas, populations were heavy enough to cause dieback and mortality of evergreen shrubs.

Status of Diseases

Annosus root rot, *Fomes annosus* (Fr.) Cke., is severe in some coniferous plantations in Rhode Island, Connecticut, and eastern New York; total mortality is about three trees per acre. Only a few reports have been received from other States. Observation of several known infection centers in Indiana, thinned in 1963 and 1964, showed little or no spread was occurring.

White pine root decline, *Verticicladiella procera* (Kendrick). An aerial photo survey with subsequent ground checking of 2,000 acres of pure and mixed white pine in northern Ohio revealed a total of 26 root decline-infected white pine trees. Red pine was attacked in Ohio and New England by the same fungus, but red pine is apparently less susceptible than white pine and mortality occurs less frequently.

Armillaria root rot, *Armillaria mellea* Vahl ex Fr. This shoestring root rot fungus was found associated with mortality of red spruce in the Green Mountain National Forest in Vermont. Overcrowding of the stand may have been a predisposing factor. Incidence of tree mortality from this disease is also increasing in northeastern Wisconsin and in Minnesota.

Cylindrocladium root rot, *Cylindrocladium scoparium* Morgan, caused severe red pine seedling losses in nurseries in southern Michigan and Minnesota and spruce seedling losses in Minnesota nurseries. Some white pine blister rust breeding stock was also lost.

Other rots. An unknown fungus or complex of fungi is causing mortality of pin oak in an annually flooded area on the Shawnee National Forest in southern Illinois. An evaluation of this problem is underway.

Oak wilt, caused by *Ceratocystis fagacearum* (Bretz) Hunt. In West Virginia approximately 3,000 oak wilt-infected trees were treated in 1971, compared to 2,588 in 1970. Nearly all the increase was in the northeastern panhandle of West Virginia. In Pennsylvania the disease incidence was about the same as 1970, approximately 1,000 trees chiefly in five counties in the southwest-central portion of the State. Most of the trees were detected from mid-July to mid-August. Additional reports of oak wilt have been received from Ohio, Indiana, western Maryland, and Minnesota.

Dutch elm disease, *Ceratocystis ulmi* (Buism.) C. Moreau. In most municipalities, Dutch elm disease killed about the same number of trees in 1971 as in 1970. At least 80,000 trees were killed in Chicago. Other cities had comparable losses of 1 to 3 percent of their trees. In some localities the disease incidence has leveled off because trees are scattered and fewer are available for infection. Five additional counties in Minnesota and one additional county in each of the States of Michigan and Wisconsin have reported diseased elms. Most of the American elms in Iowa and the southern part of Michigan are dead.

Elm phloem necrosis. The probable cause of this disease is a mycoplasm. Because this disease is difficult to identify and is similar to Dutch elm disease, no estimate of distribution and spread was made in 1971. However, dozens of infected trees were found in south-central New York, and an eastward spread is expected.

Anthracnose, caused by species of *Gnomonia, Gloeosporium, Marssonina,* and others. Little change from 1970 was observed in incidence of anthracnose on shade trees. Widespread disease occurrence continued on sycamore, white oak, and ash in eastern Pennsylvania. Hickory and buckeye leaf blotch appeared to be heavier in West Virginia in 1971 than in 1970.

Chrysomyxa needle rust, caused by *Chrysomyxa ledicola* (Pk.) Lagh. or *C. ledi* (Alb & Schw.) deBary. This rust caused severe defoliation of black spruce Christmas trees in northern Minnesota, especially in the northeast portion of the State.

Lophodermium needle cast, *Lophodermium pinastri* (Schrad) ex. Fr. Chev. Since 1966 this fungus has been causing notable losses in forest tree nurseries in the Lake States. Red and Scotch pine seedlings are often either killed or severely damaged. Increased damage to Scotch pine Christmas tree plantings was reported in 1971. Positive identification of the causal fungus was made from samples received from the Lake States, Vermont, Pennsylvania, and West Virginia.

Rhizosphaera needle rust, *Rhizosphaera kalkhoffix* Bub. Several spruce trees infected with this disease have been observed in Wisconsin and Minnesota Christmas tree plantations.

Other needle diseases, caused by species of *Hypoderma, Elytroderma, Dothistroma, Scirrhia,* and *Rhabdocline,* result in scattered damage to nurseries and Christmas tree plantations each year. Approximately 3,000 acres of Scotch pine Christmas trees were damaged during each of the last few years by *Scirrhia acicola* (Dearn) Siggers in Wisconsin. A possible Rhabdocline-resistant strain of Douglas-fir is being tested in Vermont.

White pine blister rust, *Cronartium ribicola* Fischer, has essentially stabilized in disease incidence during the last few years. Occasional severe rust infections were observed in New York and northern New England. In 1971 Pennsylvania reported no blister rust in white pine stands large enough for evaluation.

Beech bark disease, a combination of a scale insect *Cryptococcus fagi* (Baer) and a fungus *Nectria coccinea* Pers. ex Fr. Annual mortality of trees from this insect-fungus association is estimated at 12 million board feet in Vermont. The killing front extends into western Massachusetts and northeastern New York. The scale, but not the fungus, has been found in north-central Pennsylvania with many counties reporting occurrence of the complex in northeastern Pennsylvania.

Scleroderris canker, *Scleroderris lagerbergi* Gremmen, has been detected recently in northern Vermont. Disease losses are also increasing in Christmas tree plantations. A 1971 survey of 33 Christmas tree plantations revealed seven additional plantations with a high percentage of infection in each.

Hypoxylon canker of aspen, caused by *Hypoxylon pruinatum* (Klotsche) Cke. An unknown amount of aspen is damaged every year by this disease. The University of Michigan, under a Forest Service contract, is conducting a survey to determine disease severity and trend.

Dieback and/or decline, caused by a combination of factors including previous insect defoliations, root problems, drought, unsuitable site, and other factors. Fewer reports of this disease complex or situation were received in 1971. Permanent test plots of white ash in Pennsylvania showed that the incidence of dieback was decreasing. Affected trees were dying at a slower rate in 1971 than in previous years. However, in southwest Wisconsin and northeast Iowa, a butternut dieback caused losses up to 80 percent in some areas.

A shoot blight of moderate severity has been reported in red pine stands in northeast Wisconsin for approximately 10 years. Symptoms are expressed as dead current shoots often with drooping needles. Small as well as saw timber-sized trees are affected. In 1971 an apparent increased rate of spread was noted in Minnesota and Wisconsin. An evaluation is in progress which will include a more concerted effort to diagnose the problem.

Air pollution damage. Relatively few service foresters are acquainted with pollution damage symptoms. Also, pollution damage symptoms are frequently confused with those caused by nutrient deficiences, soil toxicity, drought, and scorch. Most of the more obvious cases are those caused by SO_2 which is a byproduct of the burning of coal. Sulfur dioxide damage has been found again this year in the upper Potomac Valley. Some of the symptoms observed on conifers include mottling of needles and uneven needle length. On hardwoods, sclerosis and browning of the foliage are common symptoms. Symptom patterns on both host types vary with the pollutant, species of tree, and temperature and humidity levels.

F-521526

The mottling of needles on this Virginia pine branch is caused by the atmospheric pollutant, sulfur dioxide.

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